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CONTRACT NO. DE-AC05-86OR21548

POST-REMEDIAL ACTION REPORT FOR THE QUARRY WATER TREATMENT PLANT EQUALIZATION BASIN (RU026)

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

JULY 2001 REV. 0

RECORD

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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Weldon Spring Site Remedial Action Project

Post-Remedial Action Report for the Quarry Water Treatment Plant Equalization Basin (RU026)

Revision 0

July 2001

Prepared by

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and
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U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

ABSTRACT

This report details the confirmation field activities and analytical results for contaminated materials removal associated with the quarry water treatment plant equalization basin. The area was identified as Remedial Unit (RU) 026/Confirmation Unit (CU) 397.

Remediation was designed to achieve surface As Low As Reasonably Achievable (ALARA) goals, and confirmation of the area was required to meet cleanup standards established in the *Record of Decision for Remedial Action a the Chemical Plant Area of the Weldon Spring Site*. Final confirmation data verified that the established goals and standards were achieved.

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1. INTRODUCTION

1.1 Purpose

This report details the results of soil confirmation activities associated with removal of the quarry water treatment plant equalization basin as shown in Figure 1-1. Included is information relating to walkovers, soil sampling, and the analytical results.

1.2 Scope

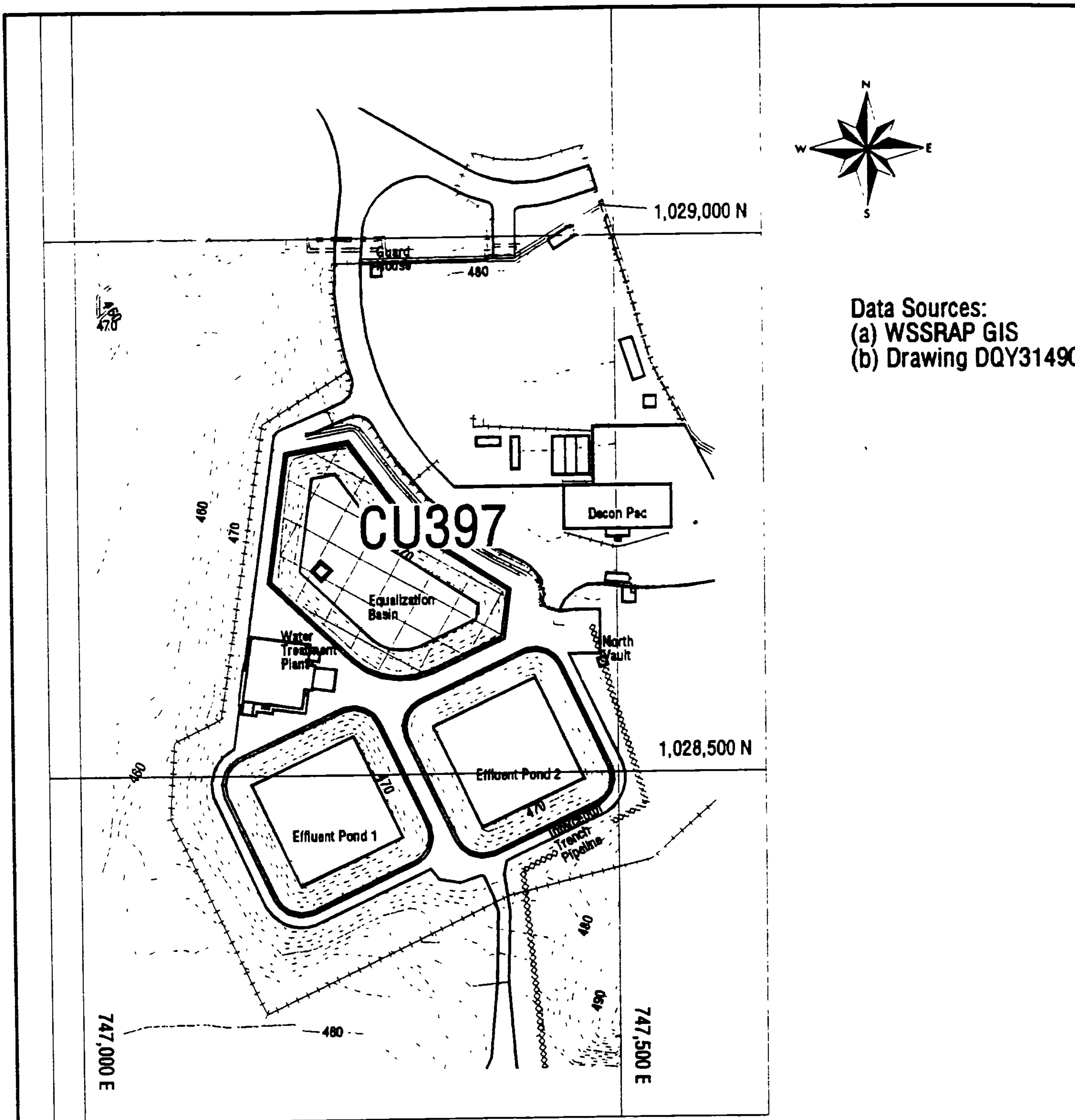
This report describes only the remedial activities and confirmation activities associated with the quarry water treatment plant equalization basin under WP551, Task D. Confirmation walkover surveys and soil sampling were conducted in accordance with the *Confirmation Sampling Plan Details for the Quarry Water Treatment Plant Equalization Basin* (Ref. 1). This plan was developed to ensure that goals established by the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Ref. 2) were accomplished, and to ensure that remediation requirements of the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Chemical Plant ROD) (Ref. 3) were met. Other areas at the quarry are covered under the *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site* (Quarry Residuals ROD) (Ref. 8); therefore, any other confirmation type activities conducted at the quarry are being handled under separate plans.

1.3 Site Description and History

The Weldon Spring site is near the community of Weldon Spring, in St. Charles County, Missouri, about 30 miles west of St. Louis. The site consists of two noncontiguous areas: the chemical plant and the quarry. The quarry is approximately 4 mi south-southwest of the chemical plant along Highway 94.

The 9-acre quarry was excavated into a bluff which forms a valley wall at the edge of the Missouri River floodplain. A small pond, 0.5 acre in size, occupied the lowest point of the quarry. Approximately 140,000 loose cu yd of bulk waste were removed from the quarry. The heterogeneous material include rubble, drummed waste, sludge, and soil contaminated with both radionuclides and chemical species. In addition, both pond water and groundwater within the saturated portions of the waste materials were contaminated.

Before remediation of the quarry began, a water treatment plant was constructed to treat contaminated water from the quarry pond. The area adjacent to the quarry proper was characterized and remediated prior to construction of the water treatment plant. Contaminants included Radium-226, Radium-228, Thorium-230, Thorium-232, and Uranium-238 as determined in the *Confirmation Sampling Plan Details for the Quarry Water Treatment Plant Equalization Basin* (Ref. 1).



Location of QWTP Equalization Basin
RU 026 CU 397

Figure: 1-1

REPORT NO:	DOE/OR/21548-890		EXHIBIT NO:	G/QY/254/0501	
ORIGINATOR:	M. G. Lutz	DRAWN BY:	AMM	DATE	21-MAY-2001

The purpose of the quarry water treatment plant was to treat contaminated water from the quarry pond. The water was contaminated due to contact with radiological and chemical (primarily TNT/DNT) wastes. The equalization basin was to retain the contaminated water prior to treatment.

1.4 Remediation and Confirmation Process

Prior to remediation, water was pumped out of the equalization basin and sediment was removed. The top liner was removed and staged for future placement into the disposal cell. The remaining geosynthetic clay liner (GCL) was scanned, sampled, and later removed as clean for off-site disposal. Confirmation samples were collected through the GCL. Another walkover was conducted once the GCL liner was removed. Additional details can be found in Sections 3 and 4

2. PRE-REMEDIATION ACTIVITIES

2.1 Identification of Contaminants of Concern

The contaminants of concern identified for CU397 included arsenic, chromium, lead, 2,4,6-trinitrotoluene (2,4,6-TNT), 2,4-dinitrotoluene (2,4-DNT), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCBs), Uranium-238 (U-238), Radium-226 (Ra-226), Radium-228 (Ra-228), Thorium-230 (Th-230) and Thorium-232 (Th-232). This list was based upon review of contaminants identified in the water prior to treatment and those required in the *RCRA Closure Document* (Ref 4)

2.2 Data Quality Objectives

Data Quality Objectives (DQOs) were identified to specify and ensure that quality data would be sufficient to support the decision making process throughout remedial activities, including the confirmation process Confirmation DQOs were developed for sampling and analyzing soils during remediation and for the subsequent data evaluation The DQOs were designed to make statistically defensible decisions regarding attainment of cleanup standards Sampling and analytical programs for the equalization basin were designed in accordance with DQOs stated in the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Attainment Plan)(Ref 2)

2.3 Cleanup Standards

The objectives of the U.S. Department of Energy (DOE) As Low As Reasonably Achievable (ALARA) process is to reduce exposures and risks associated with residual contamination The Chemical Plant ROD established two different sets of cleanup standards risk-based criteria and ALARA goals Table 2-1 summarizes the cleanup standards established in the ROD that are applicable to confirmation of the quarry water treatment plant equalization basin.

2.4 Cleanup Confirmation Process

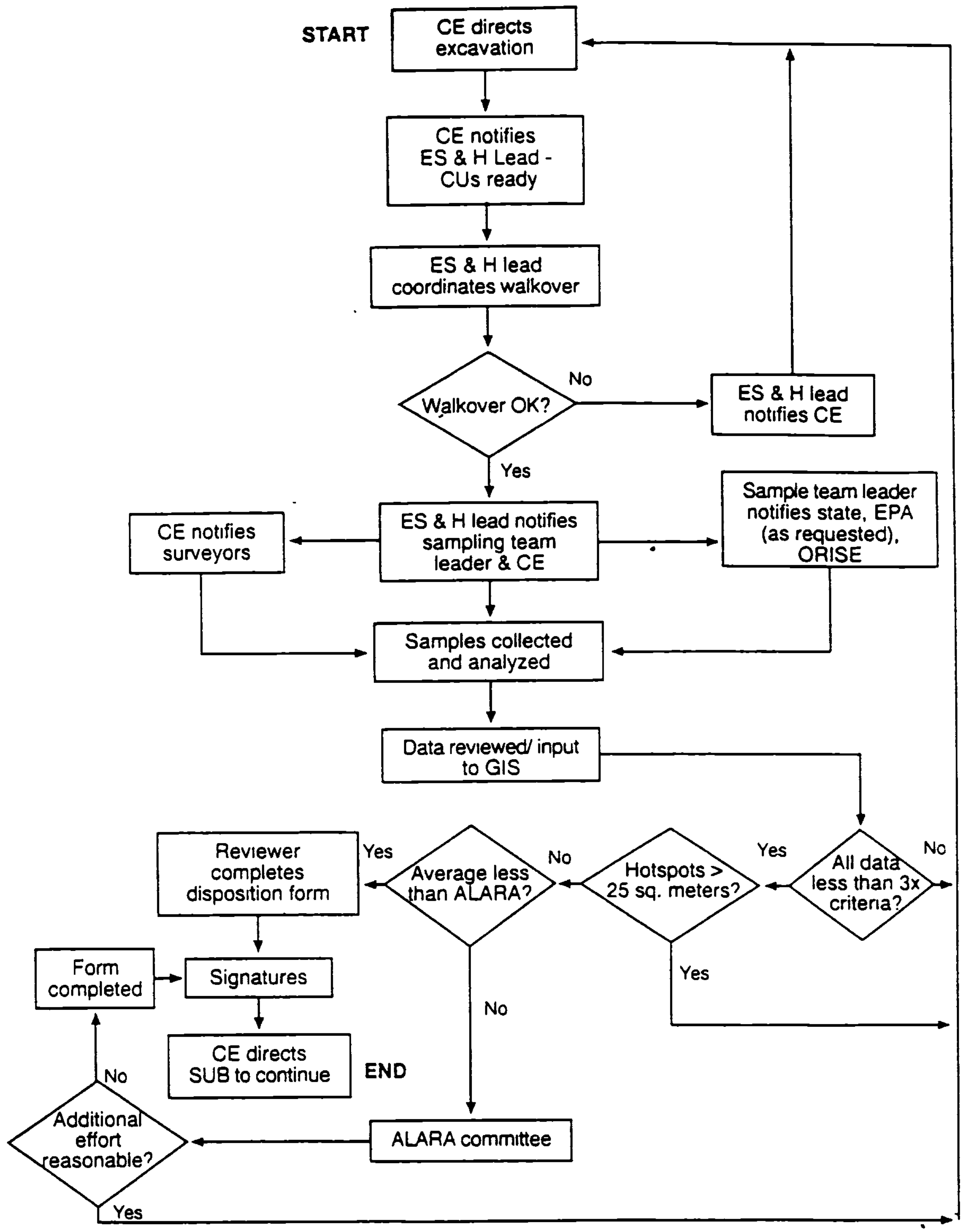
The cleanup confirmation process is used to determine if remediation activities have achieved the cleanup standards under the remedial guidelines. Figure 2-1 shows the cleanup confirmation process for remedial activities conducted within RU026. The decision making process was developed to specify how the data will be applied and evaluated within the cleanup confirmation process.

Table 2-1 ROD Cleanup Standards for COCs within RU 026

	Surface		Subsurface	
Radionuclide (pCi/g)	**ALARA**	**Criteria**	**ALARA**	**Criteria**
Radium-226	5.0	6.2	5.0	16.2
Radium-228	5.0	6.2	5.0	16.2
Thorium-230	5.0	6.2	5.0	16.2
Thorium-232	5.0	6.2	5.0	16.2
Uranium-238	30	120	30	120
Chemical (mg/kg)	ALARA	Criteria	ALARA	Criteria
Arsenic	45	75	75	750
Chromium	90	110	110	1,110
Lead	240	450	450	4,500
PAHs	0.44	5.6	5.6	56
PCBs	0.65	8.0	8.0	80
2,4,6-TNT	14	140	140	1,400
2,4-DNT	7 4	55	-	-

(a) Values listed for surface soils apply to contamination within the upper 15 cm (6 in.) of the soil column.
(b) Values for subsurface apply to contamination in soils below 15 cm (6 in.) unless otherwise noted.

Source: *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 3)



CLEANUP CONFIRMATION PROCESS			
FIGURE 2-1			
REPORT NO.: DOE/OR/21548-890		EXHIBIT NO.: A/PI/007/0397	
ORIGINATOR: MGL	DRAWN BY: GLN	DATE: 3/24/97	

3. REMEDIAL ACTIVITIES

3.1 Field Activities

Field activities completed during remediation, such as walkover surveys and soil sampling, were conducted in accordance with procedures specified in the *Confirmation Sampling Plan Details for the Quarry Water Treatment Plant Equalization Basin* (Ref. 1). Field activities were conducted to achieve and document sampling objectives specified in the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Ref. 2). All sampling and remedial action surveys were conducted and documented in accordance with Weldon Spring Site Remedial Action Project (WSSRAP) Environmental Safety and Health (ES&H) procedures.

3.1.1 Walkover Surveys

Radiological walkover surveys were conducted using a 2 in. x 2 in. NaI scintillation detector. Background radioactivity readings were collected each day. Readings were recorded in counts per minute (cpm). RU026 was surveyed twice. A walkover survey was conducted on the geosynthetic clay liner (GCL) liner and again after its removal. Results of both walkovers are summarized in Section 4 and presented in Appendix B.

3.1.2 Confirmation Sampling

Soil samples were collected after the first radiological walkover and prior to removal of the GCL liner. Sample locations were pinned as detailed in the sampling plan (Ref. 1). The samplers then cut through the liner material to reach the soil for sample collection.

3.2 Laboratory Activities

Radiological analyses for RU026 were conducted at the on-site laboratory in accordance with the *Project Management Contractor Quality Assurance Program Implementation Plan* (Ref. 5) and the *Environmental Quality Assurance Project Plan* (EQAPjP) (Ref. 6). CU releases were based on the estimated Ra-226 results. In addition, the concentration of Th-232 was calculated based on the analytical results of Ra-228 and the calculated value was used for CU releases. Both of these calculations are explained in detail in inter-office correspondences (IOCs) presented in Appendix D.

Chemical analyses for RU026 were conducted at subcontracted off-site laboratories using Contract Laboratory Program (CLP) methodologies. Summaries of the analytical results for each CU can be found in Section 4 of this report. Analytical data were subjected to data evaluation and validation upon receipt from the laboratory.

3.3 ORISE Verification Activities

The Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education (ORISE) conducted a verification survey at the equalization basin February 21, 2000. This survey included radiological walkovers and collection/analysis of soil samples The surveys and sampling were conducted in accordance with ORISE's final verification survey plan for the chemical plant area (Ref. 7).

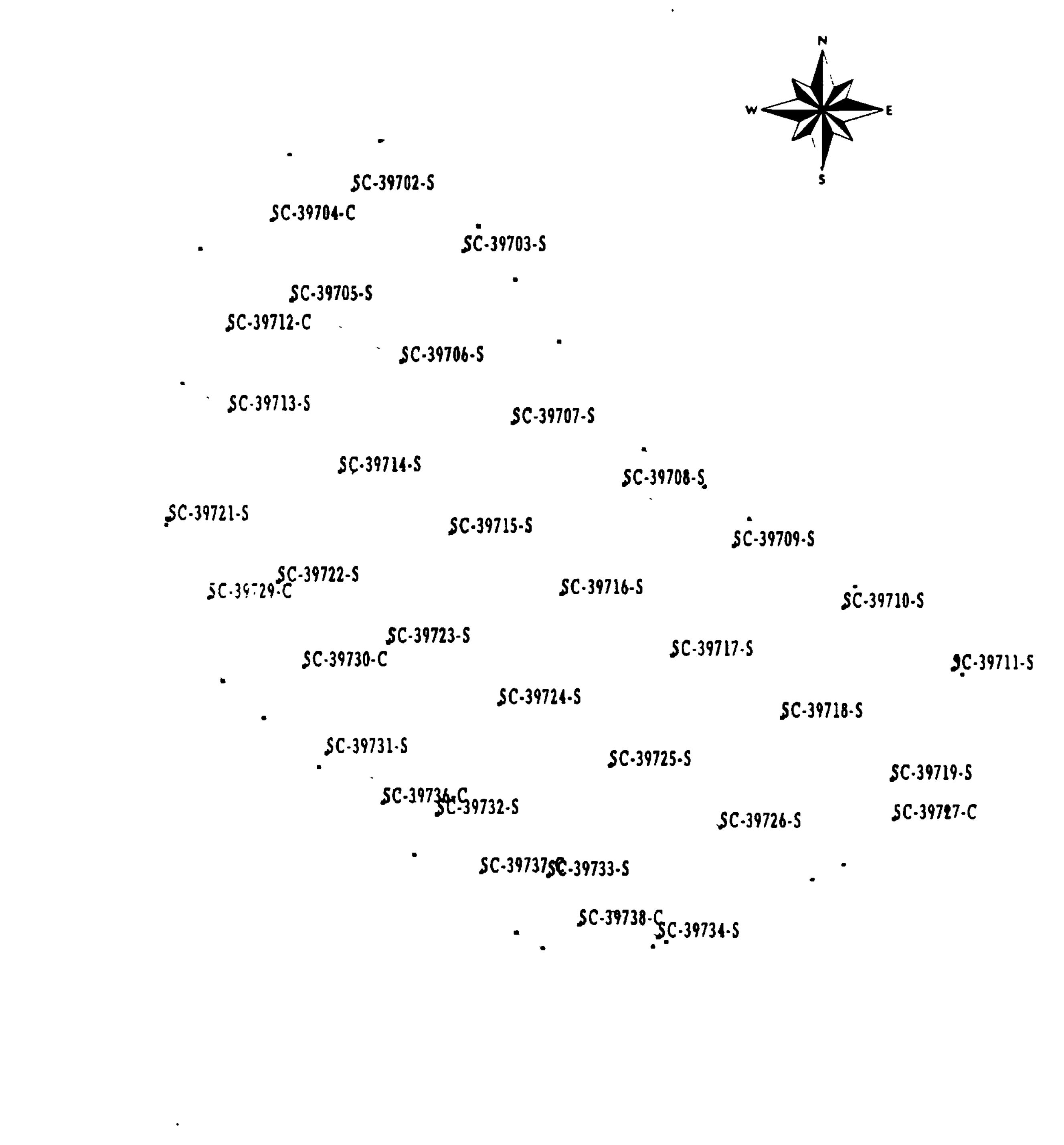
Verification was performed in order to provide independent survey and analytical data for use by the U S. Department of Energy (DOE) in determining the adequacy and accuracy of the Project Management Contractor's (PMC) conclusions regarding the status of the remediated area A final verification letter was prepared by ORISE on March 15, 2001, that addressed the quarry equalization basin (RU026 CU397). ORISE results were in agreement with PMC results, with none of the samples analyzed by ORISE exceeding the cleanup standards.

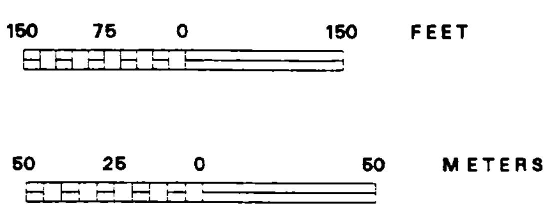
4. CONFIRMATION UNIT RESULTS SUMMARY

This section summarizes the analytical results for the one confirmation unit (CU 397) within RU026. In total, 34 locations were sampled between October and November 2000. Average concentrations for each contaminant of concern (COC) remained below the As Low As Reasonably Achievable (ALARA) goals. No hot spots were identified. All 100 m^2 averages were less than criteria.

After preliminary data were reviewed, disposition forms were completed and signed by authorized reviewers. Based on these preliminary data, all of CU397 was fully released using surface cleanup standards.

Note that the preliminary data were the initial results available immediately from the laboratory and were used for releases. These preliminary results could vary from the final results based upon laboratory quality checks or Weldon Spring Şite Remedial Action Project (WSSRAP) verification activities. Upon receipt of the data packages, the final data were reviewed and compared to the preliminary data. The final analytical results agreed with the preliminary results and indicated that the remedial activities had been completed. The final results met the cleanup standards as detailed in the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Ref. 2). Table 4-1 and the associated figure provide the confirmation details. A copy of the final walkover form can be found in Appendix A. The final data including QC, are in Appendix B. The list of coordinates is in Appendix C.





Sample Locations in Remedial Unit RU026
Confirmation Unit CU397

Figure: 4-1

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ORIGINATOR	MGL	DRAWN BY	LGB	DATE	05/02/01

Table 4-1 Summary of CU397

CU: 397 RU: 26

COC			
Ra-226	X	As	X
Ra-228	X	Cr	X
Th-230	X	Pb	X
Th-232	X	Tl	X
U-238	X	PAH	X
2,4-DNT	X	PCB	X
Reference Figure: 4-1		TNT	X

DATE RELEASED FOR UNRESTRICTED USE: 2/21/01

CLEANUP STANDARD [X] SURFACE [ ] SUBSURFACE

EACH 100m² < CRITERIA? [X] YES [ ] NO

LOCATION DESCRIPTION: *Quarry Water Treatment Plant Equalization Basin.*

WALKOVER SURVEY INFORMATION

AVG BKGD: *8,583 and 9,650* cpm

FINAL SURVEY (S) BELOW 1.5 X BACKGROUND ? [X] YES [ ] NO

DATE(S) SCANNED: *10/27/00 11/01/00 02/07/01 02/19/01*

CONFIRMATION SAMPLING INFORMATION

TOTAL # OF SAMPLE LOCATIONS : 34

HOTSPOTS? [ ] YES [X] NO

TOTAL # OF UTILITY SAMPLES : 0

ADDITIONAL EXCAVATION REQUIRED? [ ] YES [X] NO

GENERAL COMMENTS - *All results are less than ALARA. The CU was released when the final walkover was completed after removal of the GCL.*

ORISE ACTION - *ORISE conducted verification walkovers and collected unbiased samples during their visit on 02/12/01. All results are less than ALARA.*

ALARA COMMITTEE ACTION - *N/A*

CU FINAL RESULTS SUMMARY DATA

Arsenic	34	5.8 - 22.1	9.58	45	75	0	0
Chromium	34	12.7 - 21.1	16.77	90	100	0	0
Lead	34	11.6 - 20.3	14.67	240	450	0	0
PAH	34	0 - 0.040	0.001	0.44	6.5	0	0
PCB	34	0 - 0.072	0.002	0.65	8	0	0
2,4,6-TNT	34	All results < D.L.	N/A	14	140	0	0
2,4-DNT	34	All results < D.L.	N/A	7.5	55	0	0
Ra-226	34	0.85 - 1.25	1.06	5	6.2	0	0
Ra-228	34	0.40 - 1.48	1.11	5	6.2	0	0
Total Radium	34	1.36 - 2.53	2.16	5	6.2	0	0
Th-230	34	1.09 - 2.02	1.48	5	6.2	0	0
Th-232	34	0.41 - 1.52	1.14	5	6.2	0	0
U-238	34	1.04 - 2.46	1.22	30	120	0	0

NOTE: Radiological contaminants are listed in pCi/g. Chemical contaminants are mg/kg.

5. DATA EVALUATION

Evaluation was performed on the analytical data to determine whether data quality objectives developed for the Weldon Spring Site Remedial Action Project (WSSRAP) activities were met and to ensure that overall data quality results generated from RU26 remedial activities were presented. The data were evaluated in accordance with the *Project Management Contractor Quality Assurance Program* (Ref. 5) and the *Environmental Quality Assurance Project Plan* (Ref. 6). The data evaluation process included data verification, data review, data validation, and data management and reduction activities as described in the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Ref. 2).

5.1 Data Verification

Data verification was conducted in accordance with ES&H 4.9.1, *Environmental Monitoring Data Verification*, to ensure that documentation and data were reported in compliance with established reporting requirements and standard operating procedures (SOPs), and to ensure that all analyses were performed. All analytical results received from the laboratory were reviewed to verify that samples were properly handled according to WSSRAP protocol. The following factors were reviewed and evaluated: sample identification, chain of custody, holding times, sample preservation requirements, sample analysis request forms, data reviews, laboratory tracking, data reporting requirements, and the database transfer activities

5.2 Data Review

Data packages were reviewed to ensure that final data were properly identified, analyzed, reported, and met data quality requirements (DQRs). The data results were also compared to the preliminary analytical results to identify any changes in data.

During confirmation, soil samples were obtained in accordance with the details provided in the sampling plan (Ref. 1). The plan indicated that quality control samples were to be taken at a frequency of 1 per 20 samples or 5%. The quality control samples collected during this event included duplicates/matrix duplicates, matrix spike duplicates, secondary duplicates, field replicates, and equipment blanks. A complete listing of QC results is in Appendix B. All of the QC samples met the 5% frequency requirements. There were 34 sample locations; QC samples were collected at two locations.

5.2.1 Duplicates/Secondary Duplicates/Field Replicates

Duplicate (DU) samples were aliquots taken from the parent samples at the laboratory Field replicates (FR) and secondary duplicates (SD) were both split in the field from the parent samples. Field replicates were sent to the same laboratory as the parent, while the secondary duplicates were sent to different laboratories. The FR, SD, and DU results were compared to the parent samples and the relative percent difference (RPD) was calculated for each. The recommended RPD for radiological and chemical parameters is less than or equal to 50% and 35%, respectively. RPDs were not calculated when one or both of the results were non-detects. If one or both of the results were less than five times the detection limit, the RPD value was considered of limited value due to higher tolerance limits near the analytical detection limit. In cases where the RPDs were greater than the recommended limit, the data were further evaluated as discussed below.

Average RPDs for the duplicates, field replicates, and secondary duplicates were generally within recommended limits. Table 5-1 summarizes the results. Duplicate RPDs ranged between 3.2% and 15.9% for radiological and 0.7% and 12% for metals. Arsenic was the only metal that had an average RPD of 41.4%, just above the recommended RPD of 35%. Field replicate RPDs ranged between 2.1% and 27.2% for radiological and 1.5% and 52.2% for metals, and were not calculated for organics (TNT, PAHs, and PCBs) since the parent sample and/or the replicate results were non-detect. Even though some of the arsenic and lead RPDs exceeded the recommended limits, no further analysis was performed since all results, including QC, for this work package were well below their respective ALARA goals.

Secondary duplicates ranged between 12.4% and 41.1% for radiological and 1.3% and 37.3% for metals. Again, organic RPDs could not be calculated since the parent sample and/or duplicate results were non-detect.

5.2.2 Matrix Spikes/Matrix Spike Duplicates

The matrix spike and matrix spike duplicate samples were aliquots treated in the same manner as the parent samples, but spiked with a known amount of specified parameters. The samples were then processed along with the parent samples and percent recoveries (REC) were calculated after analysis. These results determined the precision of the method in a given sample matrix. In addition, the RPDs between matrix spikes and matrix spike duplicates were calculated to determine the accuracy in a given sample matrix. The matrix spikes were done for all chemical analyses, while matrix spike duplicates were applicable only to organics (i.e., PAHs, TNT).

Percent recoveries and relative percent differences for organics and metals were within acceptable limits with the exception of PAHs. The results are in Table 5-2. While the average percent recovery was 85%, the range was between 60 and 496% and the relative percent difference was just outside of expected limits. The poor percent recovery and relative percent differences are attributed to sample inhomogeneity. Further action was not requested since all sample results were less than ALARA goals.

Table 5-1 Summary of Duplicate/Field Replicate/Secondary Duplicate Samples

	Duplicates			Field Replicates			Secondary Duplicates		
Contaminant	Average RPD	RPD Range	% of samples meeting the accuracy requirements	Average RPD	RPD Range	% of samples meeting the accuracy requirements	Average RPD	RPD Range	% of samples meeting the accuracy requirements
Ra-226	7 7%	3 2 – 12.2%	100%	5%	2 1 – 7.9%	100%	26 8%	12 4 – 41 1%	100%
Ra-228	N/C	N/C	N/C	N/A*	23 9%	100%	N/A*	17 1%	100%
Th-230	15 6%	15 2 – 15 9%	100%	24 5%	21 8 – 27 2%	100%	24%	20 4 – 27.6%	100%
U-238	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Arsenic	3 1%	2 7 – 3.5%	100%	41 4%	30.5- 52.2%	50%	13%	5 – 21%	100%
Chromium	6 2%	1 3 – 11%	100%	16%	12 1 – 19.9%	100%	8.3%	1 3 – 15.3%	100%
Lead	6 4%	0 7 – 12%	100%	7%	1 52 – 12 5%	100%	24 3%	11 3 – 37 3%	50%
2,4-DNT	N/A	N/A	N/A	N/C	N/C	N/C	N/C	N/C	N/C
2,4,6-TNT	N/A	N/A	N/A	N/C	N/C	N/C	N/C	N/C	N/C
PCBs	N/A	N/A	N/A	N/C	N/C	N/C	N/C	N/C	N/C
PAHs	N/A	N/A	N/A	N/C	N/C	N/C	N/C	N/C	N/C

N/A Not applicable.
N/C Results were NDs, therefore not comparable
* Only one of the two RPDs could be calculated since one of the two results was ND

Table 5-2 Summary Table for Matrix Spike/Matrix Spike Duplicates

Contaminant	Percent Recovery		Relative Percent Difference	
	Average	Range	Average	Range
2,4-DNT - MS	79%	78 – 80%	1.43%	0.15 – 2.7%
2,4-DNT - MD	81%	80 – 81%		
2,4,6-TNT - MS	78%	77 – 78%	3.2%	3 – 3.4%
2,4,6-TNT - MD	80%	79 – 81 %		
PCBs - MS	96%	94 – 98%	8.2%	5.4 – 11%
PCBs - MD	88%	84 – 92%		
PAHs - MS	85%	60 – 170%	36%	19 – 86%
PAHs - MD	117%	61 – 496%		
Arsenic - MS	99%	97 – 100%	N/A	N/A
Chromium - MS	96%	94 – 98%	N/A	N/A
Lead - MS	91%	90 – 92%	N/A	N/A

5.2.3 Equipment Blanks

Equipment Blanks (EB) were used to monitor the effectiveness of the process used to clean equipment prior to, or between, sample collection. Equipment blank sample results showed no signs of contamination. Table 5-3 summarizes the equipment blanks.

Table 5-3 Equipment Blank Summary

Contaminant	Number of Samples	Concentration Ranges	Number of results above the DL
Ra-226	2	0.023 – 0.184	0
Ra-228	2	0.22 – 0.23	0
Th-230	2	0.51 – 0.61	1
Th-232	2	0.05 – 0.13	1
U-238	2	0.34 – 1.16	1
Arsenic	2	All results less than DL	0
Chromium	2	All results less than DL	0
Lead	2	All results less than DL	0
2,4-DNT	2	All results less than DL	0
2,4,6-TNT	2	All results less than DL	0
PCBs	2	All results less than DL	0
PAHs	2	All results less than DL	0

5.3 Data Validation

Data validation is performed on 10% of all analytical data generated from the confirmation sampling program at the WSSRAP (i.e., not specific to CU or RU) and is conducted in accordance with ES&H 4.9.2, *Environmental Monitoring Data Validation*. No data associated with RU026 were selected for validation.

6. SUMMARY OF CLOSURE REPORT FINDINGS

The quarry water treatment plant equalization basin (RU026) consisted of one Confirmation Unit (CU397). Summary information regarding the remedial activities is presented in this report.

6.1 Summary of RU026 Confirmation Results

Table 6-1 provides a summary of the total number of samples collected and analyzed for each contaminant during remedial activities conducted as part of RU026 In summary, all results were less than As Low As Reasonably Achievable (ALARA) and all 100 m^2 averages were less than ALARA. The table below was generated using data sets complied from all samples that represented soils left in place.

Table 6-1 Summary Totals for RU026

CONTAMINANT	NUMBER OF SAMPLES	CONCENTRATION RANGE	AVERAGE CONC	ALARA	CRITERIA	NUMBER GREATER THAN ALARA
Arsenic (mg/kg)	34	5 8 – 22.1	9 58	45	75	0
Chromium (mg/kg)	34	12.7 – 21 1	16 77	90	100	0
Lead (mg/kg)	34	11.6 – 20.3	14 67	240	450	0
PAH (mg/kg)	34	0 – 0.040	0 001	0 44	6 5	0
PCB (mg/kg)	34	0 – 0 072	0.002	0.65	8.0	0
TNT (mg/kg)	34	All results were < D L	N/A	14	140	0
DNT (mg/kg)	34	All results were < D.L.	N/A	7 4	55	0
Radium-226 (pCi/g)	34	0 85 – 1.25	1.06	5	6 2	0
Radium-228 (pCi/g)	34	0 40 – 1.48	1.11	5	6.2	0
Thorium-230 (pCi/g)	34	1 09 – 2 02	1 48	5	6 2	0
Thorium-232 (pCi/g)	34	0 41 – 1 52	1 14	5	6 2	0
Uranium-238 (pCi/g)	34	1 04 – 2 46	1 22	30	120	0

6.2 Summary of Cumulative Confirmation Results

To meet the requirements of the ROD, more than 50% of the results for each parameter had to be less than the ALARA goal Table 6-2 summarizes the cumulative results to date.

Table 6-2 Summary Totals for Confirmation

CONTAMINANT	NO. OF SAMPLES	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	AVERAGE CONCENTRATION	RESULTS > ALARA
Arsenic (mg/kg)	1,044	0.48	123	7.81	1
Chromium (mg/kg)	1,416	3.8	41.6	17.12	0
Lead (mg/kg)	1,141	2.4	817	16.81	2
Thallium (mg/kg)	383	0.12	19.00	1.24	1
PAH (mg/kg)	851	0.00	6.65	0.16	80
PCB (mg/kg)	1,651	0.00	6.0	0.04	21
TNT (mg/kg)	247	0.004	34	0.46	1
Toluene (mg/kg)	4	0.00	3.40	0.85	0
Radium-226 (pCi/g)	2,955	0.13	9.43	1.27	3
Radium-228 (pCi/g)	2,764	0.30	6.6	1.22	2
Thorium-230 (pCi/g)	2,013	0 09	23.1	1.55	36
Thorium-232 (pCi/g)	2,241	0 30	6.6	1.24	2
Uranium-238 (pCi/g)	4,390	0.27	228	3.64	50

NOTE. This table contains summary results from cumulative confirmation including WP-253, WP-399, WP-420, WP-458, WP-461, WP-471, WP-437 (RU016/RU017/RU018), and WP-551/Tasks D (RU026).

6.3 Comparison of Standard Deviations

The following section compares the estimated standard deviations calculated following U.S. Environmental Protection Agency (EPA) guidance and presented in the Attainment Plan (Ref 2) with deviations calculated using confirmation results. Since no existing remediation data were available to calculate the standard deviation (sigma), the Attainment Plan estimated sigma using the range (assuming the average concentration remaining after remediation would not exceed cleanup criteria) divided by six. To determine whether the specified level of precision was obtained, a comparison was made between the estimated sigma and the calculated sigma using the RU026 results.

The comparison indicated that the specified level of precision (a false positive = 0.05 and a false negative = 0.20) was obtained. All of the calculated sigmas were less than the estimated sigmas, indicating that the minimum specified precision was met. Table 6-3 presents the estimated and calculated sigmas for each COC.

Table 6-3 Comparison of Standard Deviations

Contaminant	Estimated Sigma [a]	RU026 Sigma [b]	Cumulative Sigma [c]
Arsenic	12.5	3.2	5.02
Chromium	18.3	2.4	4.86
Lead	75	1.84	28.73
Thallium	3.3	N/A	1.43
PAH	0.93	0.01	0.49
PCB	1.33	0.01	0.29
TNT	23.3	N/A	2.48
Radium-226	1.03	0.11	0.40
Radium-228	1.03	0.29	0.35
Thorium-230	1.03	0.26	1.28
Thorium-232	1.03	0.29	0.37
Uranium-238	20	0.27	8.39

(a) Sigma estimated in the Attainment Plan (Ref 2)
(b) Sigma calculated using only the RU026 confirmation results
(c) Sigma calculated using cumulative confirmation results (WP-253, WP-399, WP-420, WP-458, WP-461, WP-471, WP-437 (RU016/RU017/RU018), and WP-551/Task D [RU026])
N/A Not applicable because all results were non detects

7. REFERENCES

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2. MK-Ferguson Company and Jacobs Engineering Group. *Chemical Plant Area Cleanup Attainment Confirmation Plan*. Rev. 3. DOE/OR/21548-491. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. December 1995.

3. U.S. Department of Energy. *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site*. Rev. 0. DOE/OR/21548-376. Oak Ridge Field Office. St. Charles, MO. September 1993.

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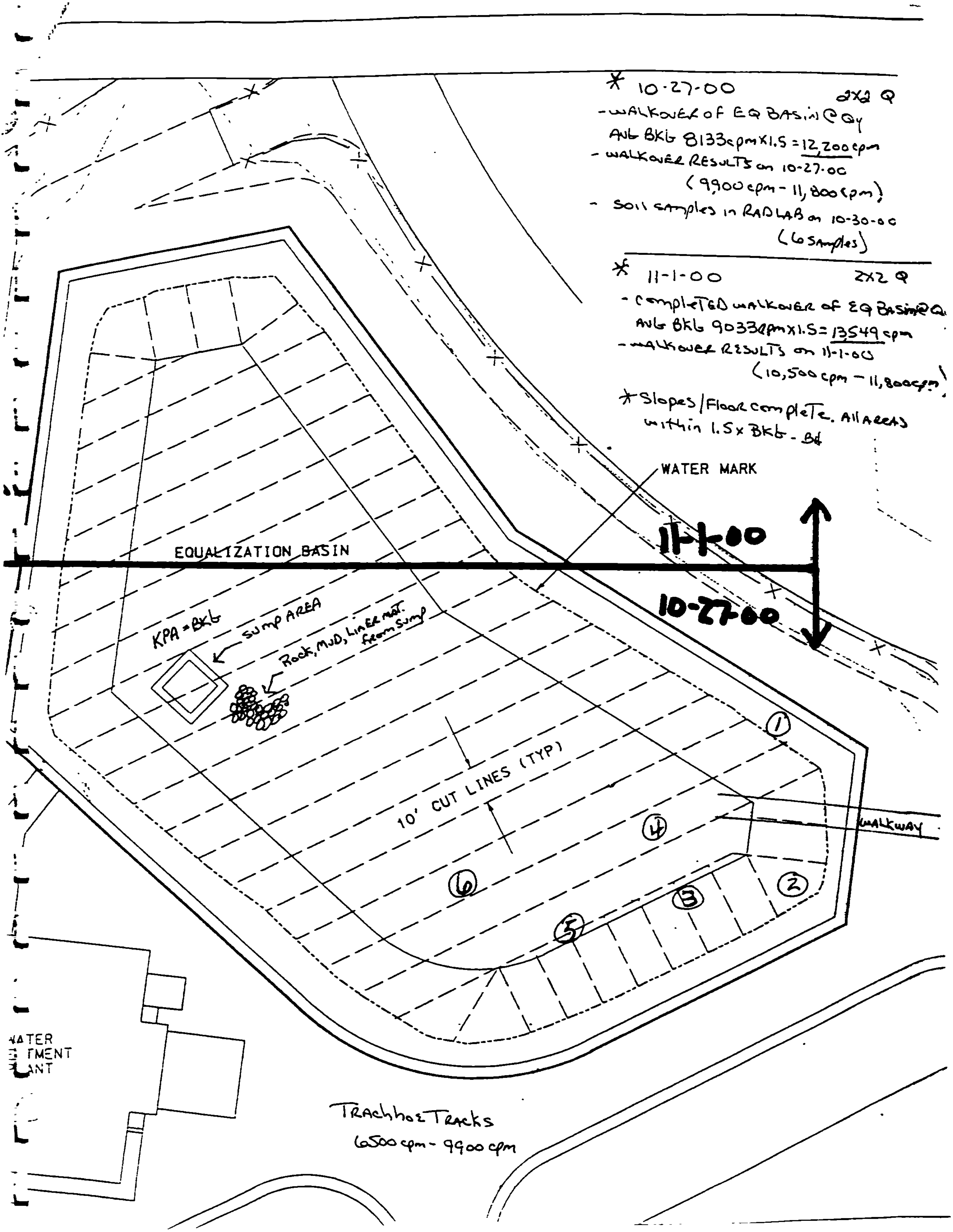
5. MK-Ferguson Company and Jacobs Engineering Group. *Project Management Contractor Quality Assurance Program Implementation Plan*. Rev. 3. DOE/OR/21548-506. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. November 2000.

6. MK-Ferguson Company and Jacobs Engineering Group. *Environmental Quality Assurance Project Plan*. Rev. 5. DOE/OR/21548-352. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. November 2000.

7. Oak Ridge Institute for Science and Education. *Final Verification Survey Plan for the Chemical Plant Area, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri.* Prepared by the Environmental Survey and Site Assessment Program, Energy/Environmental Systems Division, for the U.S. Department of Energy. St. Charles, MO. December 7, 1995.

8. Argonne National Laboratory. *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri.* No Rev. DOE/OR/21548-725. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1998.

APPENDIX A
Final Walkover Forms



* 10-27-00
2x2 Q
- WALKOVER OF EQ BASIN @ Qy
AVG BKG 8133 cpm X 1.5 = 12,200 cpm
- WALKOVER RESULTS on 10-27-00
(9900 cpm - 11,800 cpm)
- Soil samples in RADLAB on 10-30-00
(6 samples)
* 11-1-00
2X2 Q
- completed walkover of EQ Basin @ Q
AVG BKG 9033 cpm X 1.5 = 13549 cpm
- WALKOVER RESULTS on 11-1-00
(10,500 cpm - 11,800 cpm)
* Slopes/Floor complete. All Areas within 1.5 x BKG - BH
WATER MARK
11-1-00
10-27-00
EQUALIZATION BASIN
KPA = BKG
SUMP AREA
Rock, MUD, LINER MAT. from sump
10' CUT LINES (TYP)
1
2
3
4
5
6
WALKWAY
WATER
TMENT
LANT
TRACKhoe Tracks
6500 cpm - 9900 cpm

WELDON SPRING SITE REMEDIAL ACTION PROJECT

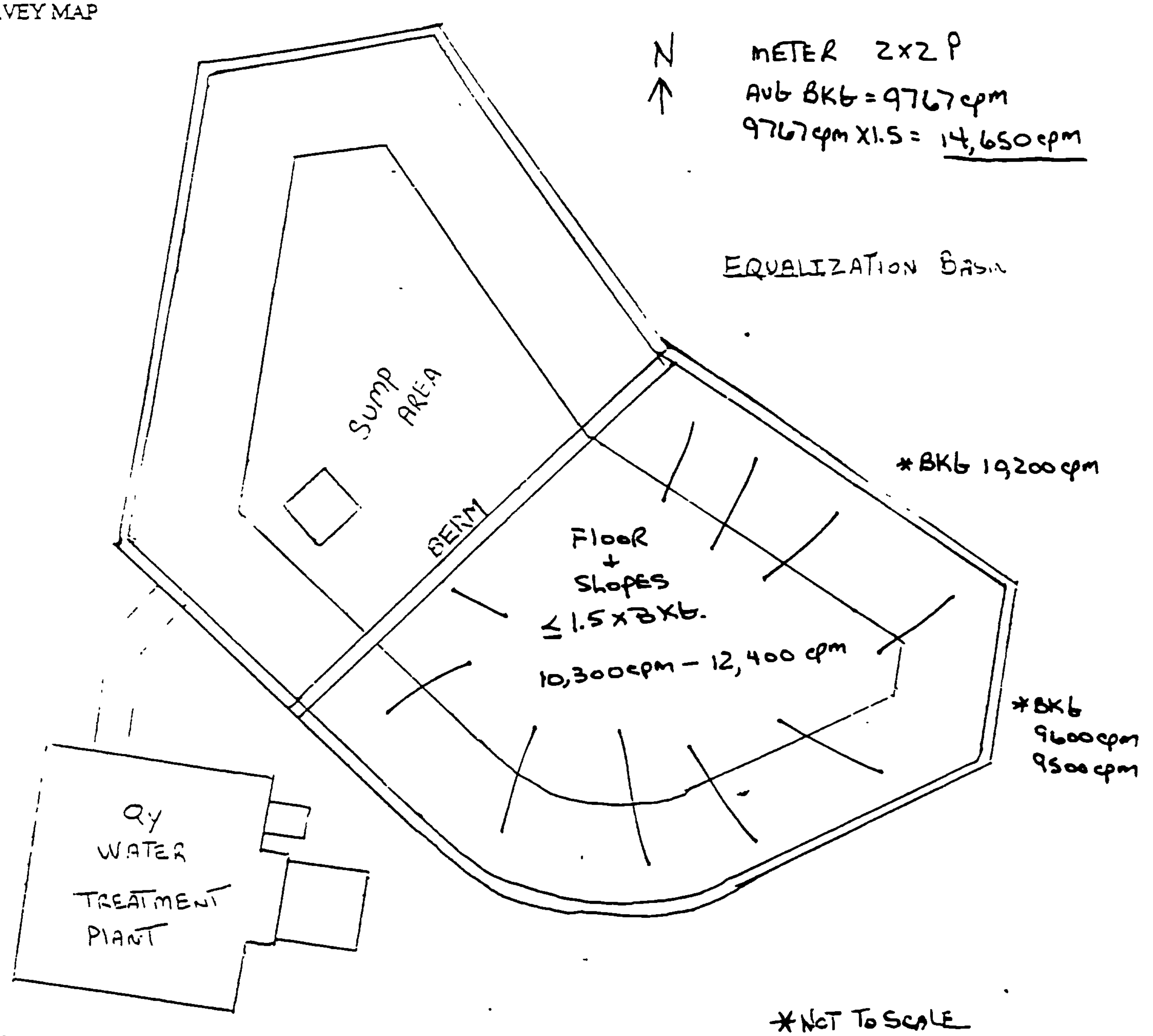
RADIOLOGICAL SURVEY REPORT (Optional Supplement)

Page ______ of ______

DESCRIPTION: Qy EQUALIZATION BASIN

DATE 2-7-01 | TIME 0900 | WP No. 551A

SURVEY MAP



REMARKS: WALKOVER RESULTS ≤1.5 x BKG (10,300 cpm – 12,400 cpm) AFTER REMOVAL of CLAY MAX

TECHNICIAN(S) SIGNATURE/DATE. [signature] / 2-7-01 ______ /

[REV]IEWER SIGNATURE/DATE. ______ /

(314) 441-8086

ES&H 2.3.8.1, Rev.16, 06/99

WELDON SPRING SITE REMEDIAL ACTION PROJECT

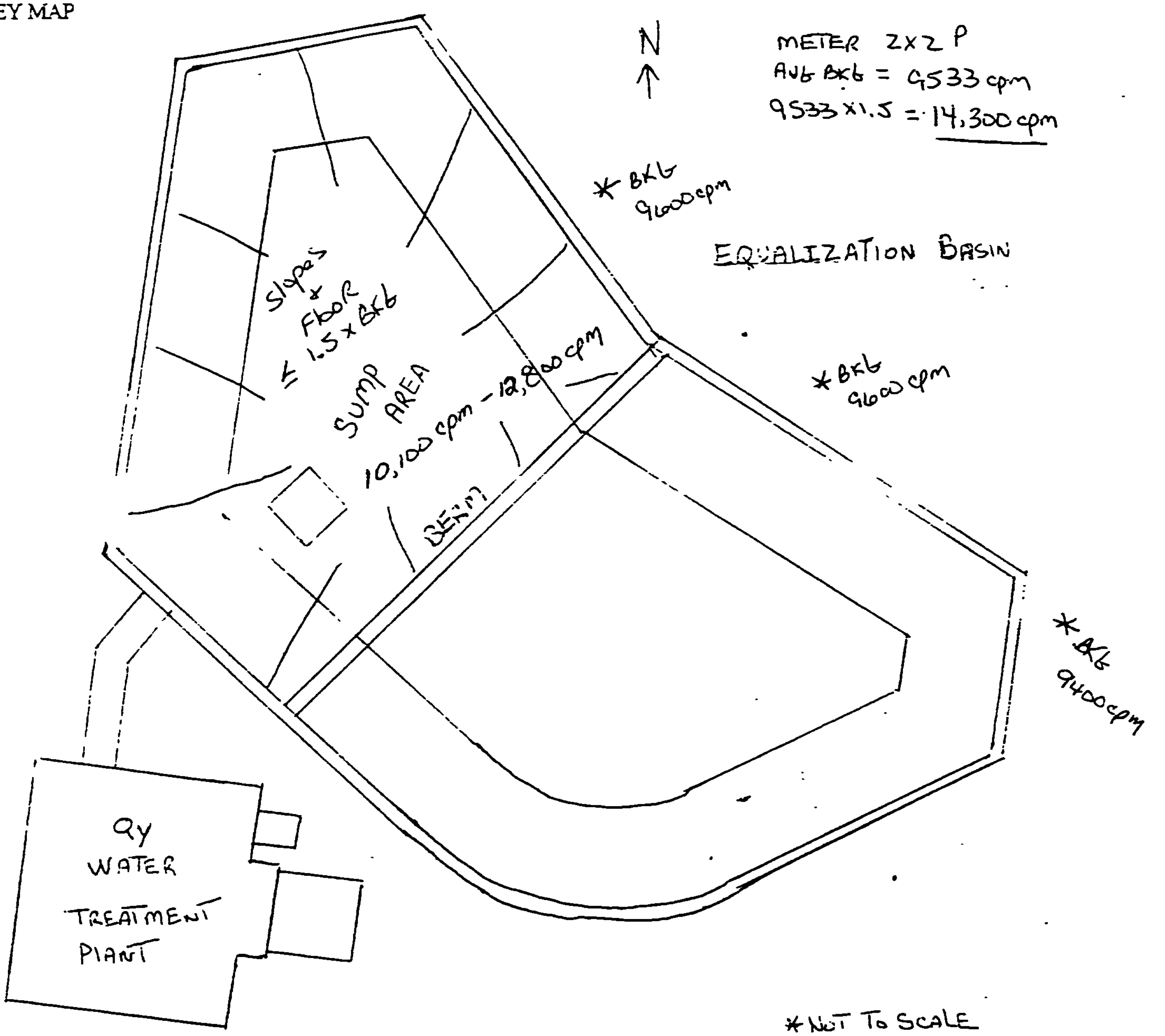
RADIOLOGICAL SURVEY REPORT (Optional Supplement)

Page ______ of ______

DESCRIPTION: Qy Equalization Basin (northern section)

DATE: 0-19-01	TIME: 0900	WP No: 551A

SURVEY MAP



REMARKS: walkover Results ≤ 1.5 x BKG (10,100 cpm - 12,800 cpm) After Removal of ClayMAX

TECHNICIAN(S) SIGNATURE/DATE: [signature] 12-19-01 ______ / ______

REVIEWER SIGNATURE/DATE: ______ / ______

APPENDIX B
Final Data

Appendix B - RU26 Final Data, including QC

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	DL	CATEGORY	UNITS
SC-39702-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39703-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39704-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39705-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39706-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39707-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.17	0.34	NITROAROMATICS	UG/G
SC-39708-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39709-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.145	0.29	NITROAROMATICS	UG/G
SC-39710-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39711-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39712-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39713-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.15	0.3	NITROAROMATICS	UG/G
SC-39714-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.175	0.35	NITROAROMATICS	UG/G
SC-39715-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.175	0.35	NITROAROMATICS	UG/G
SC-39716-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39717-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39718-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39719-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39721-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39722-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39723-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.185	0.37	NITROAROMATICS	UG/G
SC-39724-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39725-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39726-S	11/30/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39727-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39729-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39730-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39731-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39732-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39733-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.17	0.34	NITROAROMATICS	UG/G
SC-39734-S	11/29/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39736-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39737-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39738-C	11/29/2000	2,4,6-TRINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39702-S	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39703-S	11/29/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39704-C	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39705-S	11/30/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39706-S	11/30/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39707-S	11/30/2000	2,4-DINITROTOLUENE	0.17	0.34	NITROAROMATICS	UG/G
SC-39708-S	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39709-S	11/29/2000	2,4-DINITROTOLUENE	0.145	0.29	NITROAROMATICS	UG/G
SC-39710-S	11/29/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39711-S	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39712-C	11/29/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39713-S	11/29/2000	2,4-DINITROTOLUENE	0.15	0.3	NITROAROMATICS	UG/G
SC-39714-S	11/30/2000	2,4-DINITROTOLUENE	0.175	0.35	NITROAROMATICS	UG/G
SC-39715-S	11/30/2000	2,4-DINITROTOLUENE	0.175	0.35	NITROAROMATICS	UG/G
SC-39716-S	11/30/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	DL	CATEGORY	UNITS
SC-39717-S	11/30/2000	2,4-DINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39718-S	11/30/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39719-S	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39721-S	11/29/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39722-S	11/30/2000	2,4-DINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39723-S	11/30/2000	2,4-DINITROTOLUENE	0.185	0.37	NITROAROMATICS	UG/G
SC-39724-S	11/30/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39725-S	11/30/2000	2,4-DINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39726-S	11/30/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39727-C	11/29/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39729-C	11/29/2000	2,4-DINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39730-C	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39731-S	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39732-S	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39733-S	11/29/2000	2,4-DINITROTOLUENE	0.17	0.34	NITROAROMATICS	UG/G
SC-39734-S	11/29/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39736-C	11/29/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39737-C	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39738-C	11/29/2000	2,4-DINITROTOLUENE	0.16	0.32	NITROAROMATICS	UG/G
SC-39702-S	11/29/2000	ARSENIC	8.7	0.38	METALS	UG/G
SC-39703-S	11/29/2000	ARSENIC	10.2	0.38	METALS	UG/G
SC-39704-C	11/29/2000	ARSENIC	8.9	0.39	METALS	UG/G
SC-39705-S	11/30/2000	ARSENIC	10.1	0.37	METALS	UG/G
SC-39706-S	11/30/2000	ARSENIC	5.8	0.38	METALS	UG/G
SC-39707-S	11/30/2000	ARSENIC	11.9	0.41	METALS	UG/G
SC-39708-S	11/29/2000	ARSENIC	10.2	0.39	METALS	UG/G
SC-39709-S	11/29/2000	ARSENIC	7.5	0.35	METALS	UG/G
SC-39710-S	11/29/2000	ARSENIC	10.2	0.37	METALS	UG/G
SC-39711-S	11/29/2000	ARSENIC	10	0.38	METALS	UG/G
SC-39712-C	11/29/2000	ARSENIC	8.5	0.36	METALS	UG/G
SC-39713-S	11/29/2000	ARSENIC	7.9	0.36	METALS	UG/G
SC-39714-S	11/30/2000	ARSENIC	9.4	0.42	METALS	UG/G
SC-39715-S	11/30/2000	ARSENIC	8.3	0.42	METALS	UG/G
SC-39716-S	11/30/2000	ARSENIC	19.6	0.39	METALS	UG/G
SC-39717-S	11/30/2000	ARSENIC	8.2	0.4	METALS	UG/G
SC-39718-S	11/30/2000	ARSENIC	10.5	0.38	METALS	UG/G
SC-39719-S	11/29/2000	ARSENIC	7.9	0.39	METALS	UG/G
SC-39721-S	11/29/2000	ARSENIC	7.7	0.37	METALS	UG/G
SC-39722-S	11/30/2000	ARSENIC	7	0.4	METALS	UG/G
SC-39723-S	11/30/2000	ARSENIC	6.1	0.45	METALS	UG/G
SC-39724-S	11/30/2000	ARSENIC	10.3	0.38	METALS	UG/G
SC-39725-S	11/30/2000	ARSENIC	10.8	0.39	METALS	UG/G
SC-39726-S	11/30/2000	ARSENIC	7.2	0.37	METALS	UG/G
SC-39727-C	11/29/2000	ARSENIC	8.7	0.37	METALS	UG/G
SC-39729-C	11/29/2000	ARSENIC	8.4	0.4	METALS	UG/G
SC-39730-C	11/29/2000	ARSENIC	8.4	0.39	METALS	UG/G
SC-39731-S	11/29/2000	ARSENIC	8.6	0.38	METALS	UG/G
SC-39732-S	11/29/2000	ARSENIC	22.1	0.39	METALS	UG/G
SC-39733-S	11/29/2000	ARSENIC	7.7	0.41	METALS	UG/G
SC-39734-S	11/29/2000	ARSENIC	10.9	0.37	METALS	UG/G
SC-39736-C	11/29/2000	ARSENIC	8	0.38	METALS	UG/G

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	DL	CATEGORY	UNITS
SC-39737-C	11/29/2000	ARSENIC	9.9	0.38	METALS	UG/G
SC-39738-C	11/29/2000	ARSENIC	10.1	0.38	METALS	UG/G
SC-39702-S	11/29/2000	CHROMIUM	15.9	0.2	METALS	UG/G
SC-39703-S	11/29/2000	CHROMIUM	16.6	0.2	METALS	UG/G
SC-39704-C	11/29/2000	CHROMIUM	15.8	0.21	METALS	UG/G
SC-39705-S	11/30/2000	CHROMIUM	16.6	0.2	METALS	UG/G
SC-39706-S	11/30/2000	CHROMIUM	12.7	0.2	METALS	UG/G
SC-39707-S	11/30/2000	CHROMIUM	18.4	0.22	METALS	UG/G
SC-39708-S	11/29/2000	CHROMIUM	19.6	0.21	METALS	UG/G
SC-39709-S	11/29/2000	CHROMIUM	14	0.19	METALS	UG/G
SC-39710-S	11/29/2000	CHROMIUM	17.7	0.2	METALS	UG/G
SC-39711-S	11/29/2000	CHROMIUM	20.4	0.2	METALS	UG/G
SC-39712-C	11/29/2000	CHROMIUM	13.8	0.2	METALS	UG/G
SC-39713-S	11/29/2000	CHROMIUM	13.9	0.19	METALS	UG/G
SC-39714-S	11/30/2000	CHROMIUM	15.9	0.22	METALS	UG/G
SC-39715-S	11/30/2000	CHROMIUM	17.5	0.22	METALS	UG/G
SC-39716-S	11/30/2000	CHROMIUM	16.7	0.21	METALS	UG/G
SC-39717-S	11/30/2000	CHROMIUM	18.2	0.21	METALS	UG/G
SC-39718-S	11/30/2000	CHROMIUM	20.6	0.2	METALS	UG/G
SC-39719-S	11/29/2000	CHROMIUM	13.7	0.41	METALS	UG/G
SC-39721-S	11/29/2000	CHROMIUM	14.2	0.2	METALS	UG/G
SC-39722-S	11/30/2000	CHROMIUM	14.4	0.21	METALS	UG/G
SC-39723-S	11/30/2000	CHROMIUM	21.1	0.24	METALS	UG/G
SC-39724-S	11/30/2000	CHROMIUM	19.9	0.2	METALS	UG/G
SC-39725-S	11/30/2000	CHROMIUM	19.8	0.21	METALS	UG/G
SC-39726-S	11/30/2000	CHROMIUM	14.8	0.2	METALS	UG/G
SC-39727-C	11/29/2000	CHROMIUM	15.8	0.2	METALS	UG/G
SC-39729-C	11/29/2000	CHROMIUM	16.3	0.21	METALS	UG/G
SC-39730-C	11/29/2000	CHROMIUM	14.4	0.21	METALS	UG/G
SC-39731-S	11/29/2000	CHROMIUM	17.4	0.2	METALS	UG/G
SC-39732-S	11/29/2000	CHROMIUM	19	0.21	METALS	UG/G
SC-39733-S	11/29/2000	CHROMIUM	13	0.22	METALS	UG/G
SC-39734-S	11/29/2000	CHROMIUM	19.8	0.2	METALS	UG/G
SC-39736-C	11/29/2000	CHROMIUM	15.9	0.2	METALS	UG/G
SC-39737-C	11/29/2000	CHROMIUM	17.6	0.2	METALS	UG/G
SC-39738-C	11/29/2000	CHROMIUM	18.8	0.2	METALS	UG/G
SC-39702-S	11/29/2000	LEAD	16.1	0.41	METALS	UG/G
SC-39703-S	11/29/2000	LEAD	14	0.4	METALS	UG/G
SC-39704-C	11/29/2000	LEAD	14.6	0.42	METALS	UG/G
SC-39705-S	11/30/2000	LEAD	15.9	0.4	METALS	UG/G
SC-39706-S	11/30/2000	LEAD	13.1	0.41	METALS	UG/G
SC-39707-S	11/30/2000	LEAD	15.3	0.44	METALS	UG/G
SC-39708-S	11/29/2000	LEAD	13.9	0.41	METALS	UG/G
SC-39709-S	11/29/2000	LEAD	13.8	0.37	METALS	UG/G
SC-39710-S	11/29/2000	LEAD	15.6	0.4	METALS	UG/G
SC-39711-S	11/29/2000	LEAD	14	0.4	METALS	UG/G
SC-39712-C	11/29/2000	LEAD	12.8	0.39	METALS	UG/G
SC-39713-S	11/29/2000	LEAD	12.8	0.39	METALS	UG/G
SC-39714-S	11/30/2000	LEAD	16.5	0.45	METALS	UG/G
SC-39715-S	11/30/2000	LEAD	15.1	0.45	METALS	UG/G
SC-39716-S	11/30/2000	LEAD	17.5	0.41	METALS	UG/G

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SC-39717-S	11/30/2000	LEAD	16.1	0.43	METALS	UG/G
SC-39718-S	11/30/2000	LEAD	14.6	0.4	METALS	UG/G
SC-39719-S	11/29/2000	LEAD	12.5	0.21	METALS	UG/G
SC-39721-S	11/29/2000	LEAD	11.6	0.39	METALS	UG/G
SC-39722-S	11/30/2000	LEAD	13.2	0.42	METALS	UG/G
SC-39723-S	11/30/2000	LEAD	19.3	0.48	METALS	UG/G
SC-39724-S	11/30/2000	LEAD	15.3	0.41	METALS	UG/G
SC-39725-S	11/30/2000	LEAD	14.6	0.42	METALS	UG/G
SC-39726-S	11/30/2000	LEAD	14.3	0.4	METALS	UG/G
SC-39727-C	11/29/2000	LEAD	14.1	0.4	METALS	UG/G
SC-39729-C	11/29/2000	LEAD	14.1	0.43	METALS	UG/G
SC-39730-C	11/29/2000	LEAD	13.9	0.41	METALS	UG/G
SC-39731-S	11/29/2000	LEAD	13.4	0.4	METALS	UG/G
SC-39732-S	11/29/2000	LEAD	20.3	0.41	METALS	UG/G
SC-39733-S	11/29/2000	LEAD	12.6	0.44	METALS	UG/G
SC-39734-S	11/29/2000	LEAD	15.6	0.4	METALS	UG/G
SC-39736-C	11/29/2000	LEAD	12.9	0.4	METALS	UG/G
SC-39737-C	11/29/2000	LEAD	15.3	0.41	METALS	UG/G
SC-39738-C	11/29/2000	LEAD	14.2	0.41	METALS	UG/G
SC-39702-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39703-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39704-C	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39705-S	11/30/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39706-S	11/30/2000	PAH	39	19	SEMI-VOLATILES	UG/KG
SC-39707-S	11/30/2000	PAH	0	21	SEMI-VOLATILES	UG/KG
SC-39708-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39709-S	11/29/2000	PAH	40	17	SEMI-VOLATILES	UG/KG
SC-39710-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39711-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39712-C	11/29/2000	PAH	0	18	SEMI-VOLATILES	UG/KG
SC-39713-S	11/29/2000	PAH	0	18	SEMI-VOLATILES	UG/KG
SC-39714-S	11/30/2000	PAH	0	21	SEMI-VOLATILES	UG/KG
SC-39715-S	11/30/2000	PAH	0	21	SEMI-VOLATILES	UG/KG
SC-39716-S	11/30/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39717-S	11/30/2000	PAH	0	20	SEMI-VOLATILES	UG/KG
SC-39718-S	11/30/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39719-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39721-S	11/29/2000	PAH	0	18	SEMI-VOLATILES	UG/KG
SC-39722-S	11/30/2000	PAH	0	20	SEMI-VOLATILES	UG/KG
SC-39723-S	11/30/2000	PAH	0	22	SEMI-VOLATILES	UG/KG
SC-39724-S	11/30/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39725-S	11/30/2000	PAH	0	20	SEMI-VOLATILES	UG/KG
SC-39726-S	11/30/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39727-C	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39729-C	11/29/2000	PAH	0	20	SEMI-VOLATILES	UG/KG
SC-39730-C	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39731-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39732-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39733-S	11/29/2000	PAH	0	21	SEMI-VOLATILES	UG/KG
SC-39734-S	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39736-C	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG

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SC-39737-C	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39738-C	11/29/2000	PAH	0	19	SEMI-VOLATILES	UG/KG
SC-39702-S	11/29/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39703-S	11/29/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39704-C	11/29/2000	PCB	72	43	PEST/PCBS	UG/KG
SC-39705-S	11/30/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39706-S	11/30/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39707-S	11/30/2000	PCB	0	45	PEST/PCBS	UG/KG
SC-39708-S	11/29/2000	PCB	0	43	PEST/PCBS	UG/KG
SC-39709-S	11/29/2000	PCB	0	38	PEST/PCBS	UG/KG
SC-39710-S	11/29/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39711-S	11/29/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39712-C	11/29/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39713-S	11/29/2000	PCB	0	40	PEST/PCBS	UG/KG
SC-39714-S	11/30/2000	PCB	0	46	PEST/PCBS	UG/KG
SC-39715-S	11/30/2000	PCB	0	46	PEST/PCBS	UG/KG
SC-39716-S	11/30/2000	PCB	0	43	PEST/PCBS	UG/KG
SC-39717-S	11/30/2000	PCB	0	44	PEST/PCBS	UG/KG
SC-39718-S	11/30/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39719-S	11/29/2000	PCB	0	43	PEST/PCBS	UG/KG
SC-39721-S	11/29/2000	PCB	0	40	PEST/PCBS	UG/KG
SC-39722-S	11/30/2000	PCB	0	44	PEST/PCBS	UG/KG
SC-39723-S	11/30/2000	PCB	0	49	PEST/PCBS	UG/KG
SC-39724-S	11/30/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39725-S	11/30/2000	PCB	0	43	PEST/PCBS	UG/KG
SC-39726-S	11/30/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39727-C	11/29/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39729-C	11/29/2000	PCB	0	44	PEST/PCBS	UG/KG
SC-39730-C	11/29/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39731-S	11/29/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39732-S	11/29/2000	PCB	0	43	PEST/PCBS	UG/KG
SC-39733-S	11/29/2000	PCB	0	45	PEST/PCBS	UG/KG
SC-39734-S	11/29/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39736-C	11/29/2000	PCB	0	41	PEST/PCBS	UG/KG
SC-39737-C	11/29/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39738-C	11/29/2000	PCB	0	42	PEST/PCBS	UG/KG
SC-39702-S	11/29/2000	RADIUM-226	0.91	0.31	RADIOCHEMICAL	PCI/G
SC-39703-S	11/29/2000	RADIUM-226	1.24	0.24	RADIOCHEMICAL	PCI/G
SC-39704-C	11/29/2000	RADIUM-226	1.16	0.28	RADIOCHEMICAL	PCI/G
SC-39705-S	11/30/2000	RADIUM-226	1.1	0.26	RADIOCHEMICAL	PCI/G
SC-39706-S	11/30/2000	RADIUM-226	0.94	0.3	RADIOCHEMICAL	PCI/G
SC-39707-S	11/30/2000	RADIUM-226	1.04	0.29	RADIOCHEMICAL	PCI/G
SC-39708-S	11/29/2000	RADIUM-226	0.97	0.25	RADIOCHEMICAL	PCI/G
SC-39709-S	11/29/2000	RADIUM-226	0.87	0.31	RADIOCHEMICAL	PCI/G
SC-39710-S	11/29/2000	RADIUM-226	1.14	0.29	RADIOCHEMICAL	PCI/G
SC-39711-S	11/29/2000	RADIUM-226	1.02	0.28	RADIOCHEMICAL	PCI/G
SC-39712-C	11/29/2000	RADIUM-226	1.04	0.23	RADIOCHEMICAL	PCI/G
SC-39713-S	11/29/2000	RADIUM-226	1.14	0.28	RADIOCHEMICAL	PCI/G
SC-39714-S	11/30/2000	RADIUM-226	0.93	0.3	RADIOCHEMICAL	PCI/G
SC-39715-S	11/30/2000	RADIUM-226	1.11	0.24	RADIOCHEMICAL	PCI/G
SC-39716-S	11/30/2000	RADIUM-226	1.13	0.26	RADIOCHEMICAL	PCI/G

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SC-39717-S	11/30/2000	RADIUM-226	1.03	0.25	RADIOCHEMICAL	PCI/G
SC-39718-S	11/30/2000	RADIUM-226	0.95	0.27	RADIOCHEMICAL	PCI/G
SC-39719-S	11/29/2000	RADIUM-226	0.99	0.24	RADIOCHEMICAL	PCI/G
SC-39721-S	11/29/2000	RADIUM-226	0.96	0.25	RADIOCHEMICAL	PCI/G
SC-39722-S	11/30/2000	RADIUM-226	1.09	0.29	RADIOCHEMICAL	PCI/G
SC-39723-S	11/30/2000	RADIUM-226	1.15	0.26	RADIOCHEMICAL	PCI/G
SC-39724-S	11/30/2000	RADIUM-226	1.23	0.27	RADIOCHEMICAL	PCI/G
SC-39725-S	11/30/2000	RADIUM-226	0.98	0.29	RADIOCHEMICAL	PCI/G
SC-39726-S	11/30/2000	RADIUM-226	0.85	0.3	RADIOCHEMICAL	PCI/G
SC-39727-C	11/29/2000	RADIUM-226	1.17	0.21	RADIOCHEMICAL	PCI/G
SC-39729-C	11/29/2000	RADIUM-226	1.04	0.27	RADIOCHEMICAL	PCI/G
SC-39730-C	11/29/2000	RADIUM-226	1	0.24	RADIOCHEMICAL	PCI/G
SC-39731-S	11/29/2000	RADIUM-226	1.25	0.29	RADIOCHEMICAL	PCI/G
SC-39732-S	11/29/2000	RADIUM-226	1.01	0.27	RADIOCHEMICAL	PCI/G
SC-39733-S	11/29/2000	RADIUM-226	1.08	0.3	RADIOCHEMICAL	PCI/G
SC-39734-S	11/29/2000	RADIUM-226	1.2	0.28	RADIOCHEMICAL	PCI/G
SC-39736-C	11/29/2000	RADIUM-226	1.15	0.3	RADIOCHEMICAL	PCI/G
SC-39737-C	11/29/2000	RADIUM-226	1.07	0.24	RADIOCHEMICAL	PCI/G
SC-39738-C	11/29/2000	RADIUM-226	1.08	0.28	RADIOCHEMICAL	PCI/G
SC-39702-S	11/29/2000	RADIUM-228	1.02	0.55	RADIOCHEMICAL	PCI/G
SC-39703-S	11/29/2000	RADIUM-228	1.28	0.42	RADIOCHEMICAL	PCI/G
SC-39704-C	11/29/2000	RADIUM-228	0.435	0.87	RADIOCHEMICAL	PCI/G
SC-39705-S	11/30/2000	RADIUM-228	1.3	0.35	RADIOCHEMICAL	PCI/G
SC-39706-S	11/30/2000	RADIUM-228	0.42	0.84	RADIOCHEMICAL	PCI/G
SC-39707-S	11/30/2000	RADIUM-228	1.17	0.38	RADIOCHEMICAL	PCI/G
SC-39708-S	11/29/2000	RADIUM-228	1.24	0.42	RADIOCHEMICAL	PCI/G
SC-39709-S	11/29/2000	RADIUM-228	1	0.46	RADIOCHEMICAL	PCI/G
SC-39710-S	11/29/2000	RADIUM-228	1.25	0.38	RADIOCHEMICAL	PCI/G
SC-39711-S	11/29/2000	RADIUM-228	1.16	0.46	RADIOCHEMICAL	PCI/G
SC-39712-C	11/29/2000	RADIUM-228	1.18	0.33	RADIOCHEMICAL	PCI/G
SC-39713-S	11/29/2000	RADIUM-228	0.68	0.41	RADIOCHEMICAL	PCI/G
SC-39714-S	11/30/2000	RADIUM-228	1.25	0.57	RADIOCHEMICAL	PCI/G
SC-39715-S	11/30/2000	RADIUM-228	1.27	0.38	RADIOCHEMICAL	PCI/G
SC-39716-S	11/30/2000	RADIUM-228	1 24	0.47	RADIOCHEMICAL	PCI/G
SC-39717-S	11/30/2000	RADIUM-228	1.24	0.43	RADIOCHEMICAL	PCI/G
SC-39718-S	11/30/2000	RADIUM-228	1.48	0.35	RADIOCHEMICAL	PCI/G
SC-39719-S	11/29/2000	RADIUM-228	0.4	0.8	RADIOCHEMICAL	PCI/G
SC-39721-S	11/29/2000	RADIUM-228	1.22	0.36	RADIOCHEMICAL	PCI/G
SC-39722-S	11/30/2000	RADIUM-228	1.23	0.46	RADIOCHEMICAL	PCI/G
SC-39723-S	11/30/2000	RADIUM-228	1.38	0 39	RADIOCHEMICAL	PCI/G
SC-39724-S	11/30/2000	RADIUM-228	1 11	0.45	RADIOCHEMICAL	PCI/G
SC-39725-S	11/30/2000	RADIUM-228	1.4	0 43	RADIOCHEMICAL	PCI/G
SC-39726-S	11/30/2000	RADIUM-228	1.18	0.45	RADIOCHEMICAL	PCI/G
SC-39727-C	11/29/2000	RADIUM-228	1.01	0.37	RADIOCHEMICAL	PCI/G
SC-39729-C	11/29/2000	RADIUM-228	1.46	0.37	RADIOCHEMICAL	PCI/G
SC-39730-C	11/29/2000	RADIUM-228	1.23	0.41	RADIOCHEMICAL	PCI/G
SC-39731-S	11/29/2000	RADIUM-228	1.06	0.5	RADIOCHEMICAL	PCI/G
SC-39732-S	11/29/2000	RADIUM-228	1.17	0.4	RADIOCHEMICAL	PCI/G
SC-39733-S	11/29/2000	RADIUM-228	1.14	0.45	RADIOCHEMICAL	PCI/G
SC-39734-S	11/29/2000	RADIUM-228	1.19	0.35	RADIOCHEMICAL	PCI/G
SC-39736-C	11/29/2000	RADIUM-228	0.395	0.79	RADIOCHEMICAL	PCI/G

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SC-39737-C	11/29/2000	RADIUM-228	1.22	0.35	RADIOCHEMICAL	PCI/G
SC-39738-C	11/29/2000	RADIUM-228	1.17	0.49	RADIOCHEMICAL	PCI/G
SC-39702-S	11/29/2000	THORIUM-230	1.34	0.65	RADIOCHEMICAL	PCI/G
SC-39703-S	11/29/2000	THORIUM-230	1.5	0.65	RADIOCHEMICAL	PCI/G
SC-39704-C	11/29/2000	THORIUM-230	1.68	0.62	RADIOCHEMICAL	PCI/G
SC-39705-S	11/30/2000	THORIUM-230	1.32	0.65	RADIOCHEMICAL	PCI/G
SC-39706-S	11/30/2000	THORIUM-230	1.98	0.65	RADIOCHEMICAL	PCI/G
SC-39707-S	11/30/2000	THORIUM-230	1.43	0.65	RADIOCHEMICAL	PCI/G
SC-39708-S	11/29/2000	THORIUM-230	1.53	0.62	RADIOCHEMICAL	PCI/G
SC-39709-S	11/29/2000	THORIUM-230	1.87	0.65	RADIOCHEMICAL	PCI/G
SC-39710-S	11/29/2000	THORIUM-230	1.55	0.65	RADIOCHEMICAL	PCI/G
SC-39711-S	11/29/2000	THORIUM-230	1.34	0.62	RADIOCHEMICAL	PCI/G
SC-39712-C	11/29/2000	THORIUM-230	1.88	0.65	RADIOCHEMICAL	PCI/G
SC-39713-S	11/29/2000	THORIUM-230	1.57	0.62	RADIOCHEMICAL	PCI/G
SC-39714-S	11/30/2000	THORIUM-230	1.55	0.65	RADIOCHEMICAL	PCI/G
SC-39715-S	11/30/2000	THORIUM-230	1.84	0.65	RADIOCHEMICAL	PCI/G
SC-39716-S	11/30/2000	THORIUM-230	1.19	0.62	RADIOCHEMICAL	PCI/G
SC-39717-S	11/30/2000	THORIUM-230	1.32	0.65	RADIOCHEMICAL	PCI/G
SC-39718-S	11/30/2000	THORIUM-230	1.71	0.65	RADIOCHEMICAL	PCI/G
SC-39719-S	11/29/2000	THORIUM-230	1.34	0.62	RADIOCHEMICAL	PCI/G
SC-39721-S	11/29/2000	THORIUM-230	1.18	0.65	RADIOCHEMICAL	PCI/G
SC-39722-S	11/30/2000	THORIUM-230	1.91	0.64	RADIOCHEMICAL	PCI/G
SC-39723-S	11/30/2000	THORIUM-230	2.02	0.64	RADIOCHEMICAL	PCI/G
SC-39724-S	11/30/2000	THORIUM-230	1.36	0.64	RADIOCHEMICAL	PCI/G
SC-39725-S	11/30/2000	THORIUM-230	1.38	0.64	RADIOCHEMICAL	PCI/G
SC-39726-S	11/30/2000	THORIUM-230	1.27	0.64	RADIOCHEMICAL	PCI/G
SC-39727-C	11/29/2000	THORIUM-230	1.33	0.64	RADIOCHEMICAL	PCI/G
SC-39729-C	11/29/2000	THORIUM-230	1.61	0.64	RADIOCHEMICAL	PCI/G
SC-39730-C	11/29/2000	THORIUM-230	1.17	0.64	RADIOCHEMICAL	PCI/G
SC-39731-S	11/29/2000	THORIUM-230	1.1	0.64	RADIOCHEMICAL	PCI/G
SC-39732-S	11/29/2000	THORIUM-230	1.09	0.64	RADIOCHEMICAL	PCI/G
SC-39733-S	11/29/2000	THORIUM-230	1.47	0.64	RADIOCHEMICAL	PCI/G
SC-39734-S	11/29/2000	THORIUM-230	1.31	0.64	RADIOCHEMICAL	PCI/G
SC-39736-C	11/29/2000	THORIUM-230	1.24	0.64	RADIOCHEMICAL	PCI/G
SC-39737-C	11/29/2000	THORIUM-230	1.32	0.64	RADIOCHEMICAL	PCI/G
SC-39738-C	11/29/2000	THORIUM-230	1.53	0.64	RADIOCHEMICAL	PCI/G
SC-39702-S	11/29/2000	URANIUM-238	1.115	2.23	RADIOCHEMICAL	PCI/G
SC-39703-S	11/29/2000	URANIUM-238	1.19	2.38	RADIOCHEMICAL	PCI/G
SC-39704-C	11/29/2000	URANIUM-238	1.14	2.28	RADIOCHEMICAL	PCI/G
SC-39705-S	11/30/2000	URANIUM-238	1.165	2.33	RADIOCHEMICAL	PCI/G
SC-39706-S	11/30/2000	URANIUM-238	1.23	2.46	RADIOCHEMICAL	PCI/G
SC-39707-S	11/30/2000	URANIUM-238	1.2	2.4	RADIOCHEMICAL	PCI/G
SC-39708-S	11/29/2000	URANIUM-238	1.165	2.33	RADIOCHEMICAL	PCI/G
SC-39709-S	11/29/2000	URANIUM-238	1.095	2.19	RADIOCHEMICAL	PCI/G
SC-39710-S	11/29/2000	URANIUM-238	1.195	2.39	RADIOCHEMICAL	PCI/G
SC-39711-S	11/29/2000	URANIUM-238	1.21	2.42	RADIOCHEMICAL	PCI/G
SC-39712-C	11/29/2000	URANIUM-238	1.135	2.27	RADIOCHEMICAL	PCI/G
SC-39713-S	11/29/2000	URANIUM-238	1.035	2.07	RADIOCHEMICAL	PCI/G
SC-39714-S	11/30/2000	URANIUM-238	1.07	2.14	RADIOCHEMICAL	PCI/G
SC-39715-S	11/30/2000	URANIUM-238	1.235	2.47	RADIOCHEMICAL	PCI/G
SC-39716-S	11/30/2000	URANIUM-238	1.06	2.12	RADIOCHEMICAL	PCI/G

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SC-39717-S	11/30/2000	URANIUM-238	1.18	2.36	RADIOCHEMICAL	PCI/G
SC-39718-S	11/30/2000	URANIUM-238	1.23	2.46	RADIOCHEMICAL	PCI/G
SC-39719-S	11/29/2000	URANIUM-238	1.1	2.2	RADIOCHEMICAL	PCI/G
SC-39721-S	11/29/2000	URANIUM-238	1.155	2.31	RADIOCHEMICAL	PCI/G
SC-39722-S	11/30/2000	URANIUM-238	1.165	2.33	RADIOCHEMICAL	PCI/G
SC-39723-S	11/30/2000	URANIUM-238	1.205	2.41	RADIOCHEMICAL	PCI/G
SC-39724-S	11/30/2000	URANIUM-238	1.205	2.41	RADIOCHEMICAL	PCI/G
SC-39725-S	11/30/2000	URANIUM-238	1.2	2.4	RADIOCHEMICAL	PCI/G
SC-39726-S	11/30/2000	URANIUM-238	1.12	2.24	RADIOCHEMICAL	PCI/G
SC-39727-C	11/29/2000	URANIUM-238	1.185	2.37	RADIOCHEMICAL	PCI/G
SC-39729-C	11/29/2000	URANIUM-238	1.19	2.38	RADIOCHEMICAL	PCI/G
SC-39730-C	11/29/2000	URANIUM-238	1.155	2.31	RADIOCHEMICAL	PCI/G
SC-39731-S	11/29/2000	URANIUM-238	2.04	1.81	RADIOCHEMICAL	PCI/G
SC-39732-S	11/29/2000	URANIUM-238	1.2	2.4	RADIOCHEMICAL	PCI/G
SC-39733-S	11/29/2000	URANIUM-238	1.145	2.29	RADIOCHEMICAL	PCI/G
SC-39734-S	11/29/2000	URANIUM-238	2.46	1.95	RADIOCHEMICAL	PCI/G
SC-39736-C	11/29/2000	URANIUM-238	1.13	2.26	RADIOCHEMICAL	PCI/G
SC-39737-C	11/29/2000	URANIUM-238	1.095	2.19	RADIOCHEMICAL	PCI/G
SC-39738-C	11/29/2000	URANIUM-238	1.155	2.31	RADIOCHEMICAL	PCI/G

QC RESULTS

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	DL	CATEGORY	UNITS
SC-39706-S-MS	11/30/2000	2,4,6-TRINITROTOLUENE	0.391	0.32	NITROAROMATICS	UG/G
SC-39706-S-MD	11/30/2000	2,4,6-TRINITROTOLUENE	0.403	0.32	NITROAROMATICS	UG/G
SC-39706-S-EB	11/30/2000	2,4,6-TRINITROTOLUENE	0.05	0.1	NITROAROMATICS	UG/L
SC-39706-S-FR	11/30/2000	2,4,6-TRINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39706-S-SD	11/30/2000	2,4,6-TRINITROTOLUENE	0.0025	0.005	NITROAROMATICS	UG/G
SC-39726-S-EB	11/30/2000	2,4,6-TRINITROTOLUENE	0.05	0.1	NITROAROMATICS	UG/L
SC-39726-S-FR	11/30/2000	2,4,6-TRINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39726-S-MD	11/30/2000	2,4,6-TRINITROTOLUENE	0.401	0.31	NITROAROMATICS	UG/G
SC-39726-S-MS	11/30/2000	2,4,6-TRINITROTOLUENE	0.388	0.31	NITROAROMATICS	UG/G
SC-39726-S-SD	11/30/2000	2,4,6-TRINITROTOLUENE	0.0025	0.005	NITROAROMATICS	UG/G
SC-39706-S-MD	11/30/2000	2,4-DINITROTOLUENE	0.411	0.32	NITROAROMATICS	UG/G
SC-39706-S-FR	11/30/2000	2,4-DINITROTOLUENE	0.155	0.31	NITROAROMATICS	UG/G
SC-39706-S-MS	11/30/2000	2,4-DINITROTOLUENE	0.4	0.32	NITROAROMATICS	UG/G
SC-39706-S-SD	11/30/2000	2,4-DINITROTOLUENE	0.0025	0.005	NITROAROMATICS	UG/G
SC-39726-S-SD	11/30/2000	2,4-DINITROTOLUENE	0.0025	0.005	NITROAROMATICS	UG/G
SC-39726-S-MS	11/30/2000	2,4-DINITROTOLUENE	0.398	0.31	NITROAROMATICS	UG/G
SC-39726-S-MD	11/30/2000	2,4-DINITROTOLUENE	0.397	0.31	NITROAROMATICS	UG/G
SC-39726-S-FR	11/30/2000	2,4-DINITROTOLUENE	0.165	0.33	NITROAROMATICS	UG/G
SC-39706-S-FR	11/30/2000	AROCLOR-1248	20.5	41	PEST/PCBS	UG/KG
SC-39706-S-EB	11/30/2000	AROCLOR-1248	0.5	1	PEST/PCBS	UG/L
SC-39706-S-SD	11/30/2000	AROCLOR-1248	16.5	33	PEST/PCBS	UG/KG
SC-39726-S-EB	11/30/2000	AROCLOR-1248	0.5	1	PEST/PCBS	UG/L
SC-39726-S-SD	11/30/2000	AROCLOR-1248	16.5	33	PEST/PCBS	UG/KG
SC-39726-S-FR	11/30/2000	AROCLOR-1248	22	44	PEST/PCBS	UG/KG
SC-39706-S-EB	11/30/2000	AROCLOR-1254	0.5	1	PEST/PCBS	UG/L
SC-39706-S-SD	11/30/2000	AROCLOR-1254	16.5	33	PEST/PCBS	UG/KG
SC-39706-S-FR	11/30/2000	AROCLOR-1254	20.5	41	PEST/PCBS	UG/KG
SC-39726-S-FR	11/30/2000	AROCLOR-1254	22	44	PEST/PCBS	UG/KG
SC-39726-S-SD	11/30/2000	AROCLOR-1254	16.5	33	PEST/PCBS	UG/KG

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	DL	CATEGORY	UNITS
SC-39726-S-EB	11/30/2000	AROCLOR-1254	0.5	1	PEST/PCBS	UG/L
SC-39706-S-SD	11/30/2000	AROCLOR-1260	16.5	33	PEST/PCBS	UG/KG
SC-39706-S-MS	11/30/2000	AROCLOR-1260	199	42	PEST/PCBS	UG/KG
SC-39706-S-EB	11/30/2000	AROCLOR-1260	0.5	1	PEST/PCBS	UG/L
SC-39706-S-FR	11/30/2000	AROCLOR-1260	20.5	41	PEST/PCBS	UG/KG
SC-39706-S-MD	11/30/2000	AROCLOR-1260	177	42	PEST/PCBS	UG/KG
SC-39726-S-MS	11/30/2000	AROCLOR-1260	202	41	PEST/PCBS	UG/KG
SC-39726-S-MD	11/30/2000	AROCLOR-1260	192	41	PEST/PCBS	UG/KG
SC-39726-S-EB	11/30/2000	AROCLOR-1260	0.5	1	PEST/PCBS	UG/L
SC-39726-S-SD	11/30/2000	AROCLOR-1260	16.5	33	PEST/PCBS	UG/KG
SC-39726-S-FR	11/30/2000	AROCLOR-1260	22	44	PEST/PCBS	UG/KG
SC-39706-S-DU	11/30/2000	ARSENIC	5.6	0.38	METALS	UG/G
SC-39706-S-MS	11/30/2000	ARSENIC	501	0.38	METALS	UG/G
SC-39706-S-SD	11/30/2000	ARSENIC	4.7	1	METALS	UG/G
SC-39706-S-FR	11/30/2000	ARSENIC	9.9	0.37	METALS	UG/G
SC-39706-S-EB	11/30/2000	ARSENIC	4	8	METALS	UG/L
SC-39726-S-SD	11/30/2000	ARSENIC	6.1	1	METALS	UG/G
SC-39726-S-DU	11/30/2000	ARSENIC	7.4	0.37	METALS	UG/G
SC-39726-S-EB	11/30/2000	ARSENIC	4	8	METALS	UG/L
SC-39726-S-MS	11/30/2000	ARSENIC	506	0.37	METALS	UG/G
SC-39726-S-FR	11/30/2000	ARSENIC	9.9	0.4	METALS	UG/G
SC-39706-S-MD	11/30/2000	BENZO(A)ANTHRACENE	63.7	19	SEMI-VOLATILES	UG/KG
SC-39706-S-MS	11/30/2000	BENZO(A)ANTHRACENE	51	19	SEMI-VOLATILES	UG/KG
SC-39706-S-EB	11/30/2000	BENZO(A)ANTHRACENE	12.5	25	SEMI-VOLATILES	UG/L
SC-39706-S-FR	11/30/2000	BENZO(A)ANTHRACENE	95	190	SEMI-VOLATILES	UG/KG
SC-39706-S-SD	11/30/2000	BENZO(A)ANTHRACENE	12.5	25	SEMI-VOLATILES	UG/KG
SC-39726-S-EB	11/30/2000	BENZO(A)ANTHRACENE	2.5	5	SEMI-VOLATILES	UG/L
SC-39726-S-SD	11/30/2000	BENZO(A)ANTHRACENE	17.5	35	SEMI-VOLATILES	UG/KG
SC-39726-S-MS	11/30/2000	BENZO(A)ANTHRACENE	61.9	19	SEMI-VOLATILES	UG/KG
SC-39726-S-MD	11/30/2000	BENZO(A)ANTHRACENE	50.7	19	SEMI-VOLATILES	UG/KG
SC-39726-S-FR	11/30/2000	BENZO(A)ANTHRACENE	10	20	SEMI-VOLATILES	UG/KG
SC-39706-S-MD	11/30/2000	BENZO(A)PYRENE	73.3	19	SEMI-VOLATILES	UG/KG
SC-39706-S-MS	11/30/2000	BENZO(A)PYRENE	59.4	19	SEMI-VOLATILES	UG/KG
SC-39706-S-SD	11/30/2000	BENZO(A)PYRENE	12.5	25	SEMI-VOLATILES	UG/KG
SC-39706-S-FR	11/30/2000	BENZO(A)PYRENE	95	190	SEMI-VOLATILES	UG/KG
SC-39706-S-EB	11/30/2000	BENZO(A)PYRENE	12.5	25	SEMI-VOLATILES	UG/L
SC-39726-S-SD	11/30/2000	BENZO(A)PYRENE	17.5	35	SEMI-VOLATILES	UG/KG
SC-39726-S-FR	11/30/2000	BENZO(A)PYRENE	10	20	SEMI-VOLATILES	UG/KG
SC-39726-S-MD	11/30/2000	BENZO(A)PYRENE	52.9	19	SEMI-VOLATILES	UG/KG
SC-39726-S-MS	11/30/2000	BENZO(A)PYRENE	84	19	SEMI-VOLATILES	UG/KG
SC-39726-S-EB	11/30/2000	BENZO(A)PYRENE	2.5	5	SEMI-VOLATILES	UG/L
SC-39706-S-FR	11/30/2000	BENZO(B)FLUORANTHENE	95	190	SEMI-VOLATILES	UG/KG
SC-39706-S-MD	11/30/2000	BENZO(B)FLUORANTHENE	130	19	SEMI-VOLATILES	UG/KG
SC-39706-S-MS	11/30/2000	BENZO(B)FLUORANTHENE	101	19	SEMI-VOLATILES	UG/KG
SC-39706-S-EB	11/30/2000	BENZO(B)FLUORANTHENE	12.5	25	SEMI-VOLATILES	UG/L
SC-39706-S-SD	11/30/2000	BENZO(B)FLUORANTHENE	12.5	25	SEMI-VOLATILES	UG/KG
SC-39726-S-FR	11/30/2000	BENZO(B)FLUORANTHENE	10	20	SEMI-VOLATILES	UG/KG
SC-39726-S-MS	11/30/2000	BENZO(B)FLUORANTHENE	139	19	SEMI-VOLATILES	UG/KG
SC-39726-S-SD	11/30/2000	BENZO(B)FLUORANTHENE	17.5	35	SEMI-VOLATILES	UG/KG
SC-39726-S-MD	11/30/2000	BENZO(B)FLUORANTHENE	102	19	SEMI-VOLATILES	UG/KG
SC-39726-S-EB	11/30/2000	BENZO(B)FLUORANTHENE	2.5	5	SEMI-VOLATILES	UG/L

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	DL	CATEGORY	UNITS
SC-39706-S-MS	11/30/2000	BENZO(K)FLUORANTHENE	50.9	19	SEMI-VOLATILES	UG/KG
SC-39706-S-SD	11/30/2000	BENZO(K)FLUORANTHENE	12.5	25	SEMI-VOLATILES	UG/KG
SC-39706-S-MD	11/30/2000	BENZO(K)FLUORANTHENE	64.5	19	SEMI-VOLATILES	UG/KG
SC-39706-S-FR	11/30/2000	BENZO(K)FLUORANTHENE	95	190	SEMI-VOLATILES	UG/KG
SC-39706-S-EB	11/30/2000	BENZO(K)FLUORANTHENE	12.5	25	SEMI-VOLATILES	UG/L
SC-39726-S-EB	11/30/2000	BENZO(K)FLUORANTHENE	2.5	5	SEMI-VOLATILES	UG/L
SC-39726-S-MS	11/30/2000	BENZO(K)FLUORANTHENE	73.5	19	SEMI-VOLATILES	UG/KG
SC-39726-S-MD	11/30/2000	BENZO(K)FLUORANTHENE	51.9	19	SEMI-VOLATILES	UG/KG
SC-39726-S-SD	11/30/2000	BENZO(K)FLUORANTHENE	17.5	35	SEMI-VOLATILES	UG/KG
SC-39726-S-FR	11/30/2000	BENZO(K)FLUORANTHENE	10	20	SEMI-VOLATILES	UG/KG
SC-39706-S-DU	11/30/2000	CHROMIUM	14.2	0.2	METALS	UG/G
SC-39706-S-EB	11/30/2000	CHROMIUM	2.5	5	METALS	UG/L
SC-39706-S-FR	11/30/2000	CHROMIUM	15.5	0.2	METALS	UG/G
SC-39706-S-SD	11/30/2000	CHROMIUM	13.9	1	METALS	UG/G
SC-39706-S-MS	11/30/2000	CHROMIUM	60.8	0.2	METALS	UG/G
SC-39726-S-SD	11/30/2000	CHROMIUM	13.7	1	METALS	UG/G
SC-39726-S-DU	11/30/2000	CHROMIUM	15	0.2	METALS	UG/G
SC-39726-S-EB	11/30/2000	CHROMIUM	2 5	5	METALS	UG/L
SC-39726-S-MS	11/30/2000	CHROMIUM	63.6	0.2	METALS	UG/G
SC-39726-S-FR	11/30/2000	CHROMIUM	16.7	0.21	METALS	UG/G
SC-39706-S-MD	11/30/2000	CHRYSENE	461	19	SEMI-VOLATILES	UG/KG
SC-39706-S-FR	11/30/2000	CHRYSENE	1000	190	SEMI-VOLATILES	UG/KG
SC-39706-S-SD	11/30/2000	CHRYSENE	12.5	25	SEMI-VOLATILES	UG/KG
SC-39706-S-EB	11/30/2000	CHRYSENE	12.5	25	SEMI-VOLATILES	UG/L
SC-39706-S-MS	11/30/2000	CHRYSENE	184	19	SEMI-VOLATILES	UG/KG
SC-39726-S-MD	11/30/2000	CHRYSENE	168	19	SEMI-VOLATILES	UG/KG
SC-39726-S-FR	11/30/2000	CHRYSENE	10	20	SEMI-VOLATILES	UG/KG
SC-39726-S-MS	11/30/2000	CHRYSENE	78.1	19	SEMI-VOLATILES	UG/KG
SC-39726-S-SD	11/30/2000	CHRYSENE	17.5	35	SEMI-VOLATILES	UG/KG
SC-39726-S-EB	11/30/2000	CHRYSENE	2.5	5	SEMI-VOLATILES	UG/L
SC-39706-S-MD	11/30/2000	INDENO(1,2,3-CD)PYRENE	64.7	19	SEMI-VOLATILES	UG/KG
SC-39706-S-MS	11/30/2000	INDENO(1,2,3-CD)PYRENE	53.4	19	SEMI-VOLATILES	UG/KG
SC-39706-S-SD	11/30/2000	INDENO(1,2,3-CD)PYRENE	12.5	25	SEMI-VOLATILES	UG/KG
SC-39706-S-EB	11/30/2000	INDENO(1,2,3-CD)PYRENE	12.5	25	SEMI-VOLATILES	UG/L
SC-39706-S-FR	11/30/2000	INDENO(1,2,3-CD)PYRENE	95	190	SEMI-VOLATILES	UG/KG
SC-39726-S-FR	11/30/2000	INDENO(1,2,3-CD)PYRENE	10	20	SEMI-VOLATILES	UG/KG
SC-39726-S-MS	11/30/2000	INDENO(1,2,3-CD)PYRENE	78.3	19	SEMI-VOLATILES	UG/KG
SC-39726-S-SD	11/30/2000	INDENO(1,2,3-CD)PYRENE	17.5	35	SEMI-VOLATILES	UG/KG
SC-39726-S-EB	11/30/2000	INDENO(1,2,3-CD)PYRENE	2.5	5	SEMI-VOLATILES	UG/L
SC-39726-S-MD	11/30/2000	INDENO(1,2,3-CD)PYRENE	54.7	19	SEMI-VOLATILES	UG/KG
SC-39706-S-SD	11/30/2000	LEAD	11.7	5	METALS	UG/G
SC-39706-S-FR	11/30/2000	LEAD	13.3	0.4	METALS	UG/G
SC-39706-S-DU	11/30/2000	LEAD	14.7	0.41	METALS	UG/G
SC-39706-S-EB	11/30/2000	LEAD	1.5	3	METALS	UG/L
SC-39706-S-MS	11/30/2000	LEAD	128	0.41	METALS	UG/G
SC-39726-S-DU	11/30/2000	LEAD	14.2	0.4	METALS	UG/G
SC-39726-S-FR	11/30/2000	LEAD	16.2	0.42	METALS	UG/G
SC-39726-S-SD	11/30/2000	LEAD	9.8	5	METALS	UG/G
SC-39726-S-EB	11/30/2000	LEAD	1.5	3	METALS	UG/L
SC-39726-S-MS	11/30/2000	LEAD	129	0.4	METALS	UG/G
SC-39706-S-SD	11/30/2000	RADIUM-226	0.826	0.112	RADIOCHEMICAL	PCI/G

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	DL	CATEGORY	UNITS
SC-39706-S-FR	11/30/2000	RADIUM-226	0.96	0.25	RADIOCHEMICAL	PCI/G
SC-39706-S-EB	11/30/2000	RADIUM-226	0.023	0.116	RADIOCHEMICAL	PCI/L
SC-39706-S-DU	11/30/2000	RADIUM-226	0.91	0.29	RADIOCHEMICAL	PCI/G
SC-39726-S-EB	11/30/2000	RADIUM-226	0.184	0.368	RADIOCHEMICAL	PCI/L
SC-39726-S-DU	11/30/2000	RADIUM-226	0.96	0.29	RADIOCHEMICAL	PCI/G
SC-39726-S-FR	11/30/2000	RADIUM-226	0.92	0.33	RADIOCHEMICAL	PCI/G
SC-39726-S-SD	11/30/2000	RADIUM-226	1.29	0.158	RADIOCHEMICAL	PCI/G
SC-39706-S-FR	11/30/2000	RADIUM-228	1.19	0.44	RADIOCHEMICAL	PCI/G
SC-39706-S-EB	11/30/2000	RADIUM-228	0.22	0.469	RADIOCHEMICAL	PCI/L
SC-39706-S-DU	11/30/2000	RADIUM-228	0.405	0.81	RADIOCHEMICAL	PCI/G
SC-39706-S-SD	11/30/2000	RADIUM-228	0.77	0.155	RADIOCHEMICAL	PCI/G
SC-39726-S-SD	11/30/2000	RADIUM-228	1.4	0.292	RADIOCHEMICAL	PCI/G
SC-39726-S-FR	11/30/2000	RADIUM-228	1.5	0.5	RADIOCHEMICAL	PCI/G
SC-39726-S-DU	11/30/2000	RADIUM-228	0.395	0.79	RADIOCHEMICAL	PCI/G
SC-39726-S-EB	11/30/2000	RADIUM-228	0.2345	0.469	RADIOCHEMICAL	PCI/L
SC-39706-S-EB	11/30/2000	THORIUM-228	0.064	0.119	RADIOCHEMICAL	PCI/L
SC-39706-S-SD	11/30/2000	THORIUM-228	1.08	0.067	RADIOCHEMICAL	PCI/G
SC-39726-S-SD	11/30/2000	THORIUM-228	0.584	0.104	RADIOCHEMICAL	PCI/G
SC-39726-S-EB	11/30/2000	THORIUM-228	0.061	0.076	RADIOCHEMICAL	PCI/L
SC-39706-S-EB	11/30/2000	THORIUM-230	0.614	0.1	RADIOCHEMICAL	PCI/L
SC-39706-S-FR	11/30/2000	THORIUM-230	1.59	0.65	RADIOCHEMICAL	PCI/G
SC-39706-S-SD	11/30/2000	THORIUM-230	1.5	0.101	RADIOCHEMICAL	PCI/G
SC-39706-S-DU	11/30/2000	THORIUM-230	1.7	0.62	RADIOCHEMICAL	PCI/G
SC-39726-S-SD	11/30/2000	THORIUM-230	1.56	0.089	RADIOCHEMICAL	PCI/G
SC-39726-S-FR	11/30/2000	THORIUM-230	1.67	0.64	RADIOCHEMICAL	PCI/G
SC-39726-S-DU	11/30/2000	THORIUM-230	1.49	0.64	RADIOCHEMICAL	PCI/G
SC-39726-S-EB	11/30/2000	THORIUM-230	0.506	0.121	RADIOCHEMICAL	PCI/L
SC-39706-S-SD	11/30/2000	THORIUM-232	1.38	0.058	RADIOCHEMICAL	PCI/G
SC-39706-S-EB	11/30/2000	THORIUM-232	0.129	0.087	RADIOCHEMICAL	PCI/L
SC-39726-S-EB	11/30/2000	THORIUM-232	0.052	0.063	RADIOCHEMICAL	PCI/L
SC-39726-S-SD	11/30/2000	THORIUM-232	0.689	0.079	RADIOCHEMICAL	PCI/G
SC-39706-S-EB	11/30/2000	URANIUM, TOTAL	0.3385	0.677	RADIOCHEMICAL	PCI/L
SC-39726-S-EB	11/30/2000	URANIUM, TOTAL	1.16	0.677	RADIOCHEMICAL	PCI/L
SC-39706-S-SD	11/30/2000	URANIUM-238	1.95	0.675	RADIOCHEMICAL	PCI/G
SC-39706-S-DU	11/30/2000	URANIUM-238	2.25	2.64	RADIOCHEMICAL	PCI/G
SC-39706-S-FR	11/30/2000	URANIUM-238	1.155	2.31	RADIOCHEMICAL	PCI/G
SC-39726-S-DU	11/30/2000	URANIUM-238	1.095	2.19	RADIOCHEMICAL	PCI/G
SC-39726-S-FR	11/30/2000	URANIUM-238	1.205	2.41	RADIOCHEMICAL	PCI/G
SC-39726-S-SD	11/30/2000	URANIUM-238	2.06	0.549	RADIOCHEMICAL	PCI/G

APPENDIX C
Coordinates

Quarry Water Treatment Plant Equalization Basin – CU397 Coordinate List

Sample ID	Northing	Easting	Elevation
SC-39702-S	1028791.26	747236.34	473.47
SC-39703-S	1028775.24	747265.2	476.29
SC-39704-C	1028783.78	747215.4	471.54
SC-39705-S	1028762.82	747220.37	468.09
SC-39706-S	1028746.61	747248.95	467.86
SC-39707-S	1028730.71	747277.89	468.82
SC-39708-S	1028714.68	747306.44	474.54
SC-39709-S	1028698.6	747334.98	475.86
SC-39710-S	1028682.48	747363.71	476.4
SC-39711-S	1028666.76	747392.12	478.58
SC-39712-C	1028755.36	747203.72	472.4
SC-39713-S	1028734.18	747204.54	470.77
SC-39714-S	1028717.7	747232.64	467.06
SC-39715-S	1028702.55	747262.03	466.85
SC-39716-S	1028686.07	747290.26	467.58
SC-39717-S	1028670.24	747318.32	468.2
SC-39718-S	1028653.88	747347.54	468.7
SC-39719-S	1028638.26	747376.06	472.7
SC-39721-S	1028705.34	747188.42	476.58
SC-39722-S	1028689.62	747217.37	466.06
SC-39723-S	1028673.56	747245.71	467.04
SC-39724-S	1028657.4	747274.21	467.72
SC-39725-S	1028641.68	747302.91	468.13
SC-39726-S	1028625.21	747331.4	469.08
SC-39727-C	1028627.99	747376.64	476.52
SC-39729-C	1028685.62	747199.27	470.7
SC-39730-C	1028667 46	747223.68	468.29
SC-39731-S	1028644.38	747229.53	475.23
SC-39732-S	1028629 11	747258.63	471.22
SC-39733-S	1028612.71	747286.73	470.58
SC-39734-S	1028596.9	747315.56	478.07
SC-39736-C	1028631.96	747244.5	474.98
SC-39737-C	1028614.06	747269.57	473.83
SC-39738-C	1028600.06	747294.87	475.42

APPENDIX D
Inter-Office Correspondence

MORRISON KNUDSEN CORPORATION

MK-FERGUSON GROUP

INTER-OFFICE CORRESPONDENCE

DATE: November 17, 1995

TO: ALARA Committee

FROM: Michelle French/Richard Machado

SUBJECT: **RA-226 DETERMINATION FOR SITE CONFIRMATION SAMPLES**

Background

The issue surrounding Ra-226 analysis via gamma spectroscopy arises due to the fact that the Ra-226 soil concentration is determined by using the following energy peaks: 295 keV and 352 keV for Pb-214; and 609 keV, 1120 keV, and 1764 keV for Bi-214. These radionuclides are both short-lived daughters of Rn-222. The drying and grinding processes are known to drive off Rn-222 that is trapped in the soil pores and moisture held in the soil. In order to quantitatively identify Ra-226 using gamma spectroscopy, Rn-222 and its short-lived progeny must be allowed to grow into secular equilibrium following such sample preparation techniques. The following alternatives were evaluated for estimating the Ra-226 concentration in soil given gamma spectroscopy analysis within five working days of sample collection.

Alternative 1

Send all samples requiring Ra-226 analysis to an offsite laboratory. At offsite facilities, Ra-226 is typically analyzed through alpha spectroscopy which does not rely on the Ra-222 daughter products to provide a quantitative result. The minimum turnaround time that can be provided for alpha spectroscopy analysis for Ra-226 is four days. At one and two day turnaround times, the method for analysis is modified to use Gas Flow Proportional Counting for total alpha counting yielding a total radium number with no separation of isotopic contributions. Given the four day turnaround time and an estimate of 750 samples (WP-253 and WP-420), the total analytical costs will be $95,250.

The major disadvantage in this approach is the tight schedule involved with sample collection, packaging, shipping, data receipt, data review, and ALARA committee action. It may be impossible to accomplish this within five working days given the four day turnaround requirement.

11-30-95

Alternative 2

As stated above, the drying and grinding processes are known to drive off radon that is trapped in the soil matrix. However, the amount of radon removed from these processes is not quantified. If you were to assume that all the radon is removed during these processes and the time of final preparation was recorded, a correction factor can be applied based upon the secular equilibrium condition equation. For example, the following table summarizes the ratio of activity of Rn-222 to the activity of Ra-226.

A(Rn-222)/A(Ra-226)	Time Post Canning (Days)
0.167	1
0.306	2
0.422	3
0.665	6
0.807	9
0.888	12
0.935	15
0.963	18
0.978	21
0.987	24
0.993	27
0.996	30

Thus, if the samples were counted three days post canning, a correction factor of 0.422 would be used to determine the estimated final Ra-226 concentration. Given this approach, any concentration determined three days post preparation would be divided by 0.422 to arrive at the final concentration. For a 5 pCi/g ALARA goal, any result above 2.1 pCi/g would be rejected.

The major limitation with this approach is the assumption that the drying and grinding processes remove 100% of the radon. Samples that have been analyzed within one day of preparation have never yielded results much below expected background concentrations (0.8-1.0 pCi/g).

Thus, the use of a correction factor on the order of 0.167 could result in a very conservative approach for estimating the final Ra-226 soil concentration in background soils (in fact all samples analyzed one day after canning would equal or exceed 5 pCi/g).

Alternative 3

All samples that are collected to support confirmation can be analyzed as wet samples to virtually eliminate the radon removal that occurs during sample preparation. However, there are numerous considerations, such as sample homogeneity, particle size, moisture content variability, etc., that can produce error in such analyses. If the samples are analyzed wet, they would also be prepared and analyzed to provide final concentrations for each radionuclide of interest for the sample. This dry evaluation would require an analysis within the confirmation cleanup turnaround period and a second analysis within 20-30 days later to finalize Ra-226 concentrations to an acceptable quality level. This approach would involve three analyses of every sample. The initial wet analysis can be used to estimate the final Ra-226 concentration. However, this estimate must be made on a case by case basis through moisture corrections, etc.

The major limitation for this approach is the reduction in lab productivity as an extra canning effort would be needed to generate a wet and a dry sample for each sample and count time for each sample would increase by a factor of three.

Alternative 4

Over the last several months, the onsite radiological laboratory has been recounting samples that were analyzed during the months of April - September 1995. These reanalyses were done in order to support final analyses of SE Drainage and Quarry characterization samples. The graph on the attached page illustrates a portion of the recount results versus the initial results. The graph includes those samples that had initial Ra-226 results < 5 pCi/g. As illustrated, the background - 2.2 pCi/g sample range had 100% of all sample recounts fall less than 5 pCi/g. For those in the range of 2.2 - 3.2 pCi/g, the likelihood of exceeding 5 pCi/g was approximately 50%. All of the samples with initial results greater than 3.2 pCi/g had final Ra-226 results > 5 pCi/g.

This information can be used to establish a criteria about which samples can be said to meet the ALARA goal of 5 pCi/g within the five working day turnaround window.

Given the current study findings, it is recommended that any sample with an initial Ra-226 result > 2.2 pCi/g be expected to exceed the ALARA goal of 5 pCi/g. In addition, the estimated final Ra-226 soil concentration should be found by multiplying the initial result by 2.27 (2.2 pCi/g x 2.27 = 5 pCi/g). This correction factor is very close to the maximum increase from initial results to recount results (e.g., 2.56) in the background to 2.2 pCi/g concentration range. The average increase from initial results to recount results for this range was 1.51. However, use of a value closer to the maximum value affords less risk in exceeding expected confirmation goals. The laboratory will work to refine these numbers to further minimize the risk as they continue to recount samples collected over the last few months. The major limitation with this alternative is the potential to over excavate, increasing disposal costs.

Alternative 5

This alternative involves a combination of alternatives 3 and 4. Samples that do not have elevated direct survey results via a 2x2 NaI or a 44-9 survey should be prepared and evaluated in accordance with alternative 4. Samples that do have above background survey results will be analyzed wet and evaluated accordingly to determine the estimated final Ra-226 concentration. The sample will then be prepared and analyzed a second time to provide quality level data for the other radionuclides of interest. In addition, each prepared sample would be analyzed within 30 days after preparation to finalize the Ra-226 concentration to an acceptable quality level.

The major limitation with this approach is the loss in productivity as a result of the double canning needs and increased count times for a portion of the samples.

Recommendation

The Onsite Radiological Laboratory recommends the use of alternative 4. This alternative minimizes risk of failing to meet expected cleanup ALARA goals and provides for maximum efficiency/productivity within the laboratory. The second favorable alternative is number 5. This alternative would increase the workload in the laboratory, but would further reduce the risk of over excavation and failure to meet desired cleanup objectives.

In all of the above alternatives, the estimated final Ra-226 concentration will be used in conjunction with the measured Ra-228 concentration as follows to determine if the mixture rule for the ALARA goals as described in the Record of Decision is achieved.

$$\frac{\text{Est. Final Ra-226 (pCi/g)}}{\text{5 pCi/g}} + \frac{\text{Ra-228 (pCi/g)}}{\text{5 pCi/g}} = \text{Mixture Ratio}$$

If mixture ratio <= 1, then the sample meets cleanup confirmation design. If mixture ratio > 1, then the sample must be considered by the ALARA committee.

MLF/RM/pr

Attachment

<u>Distribution:</u>

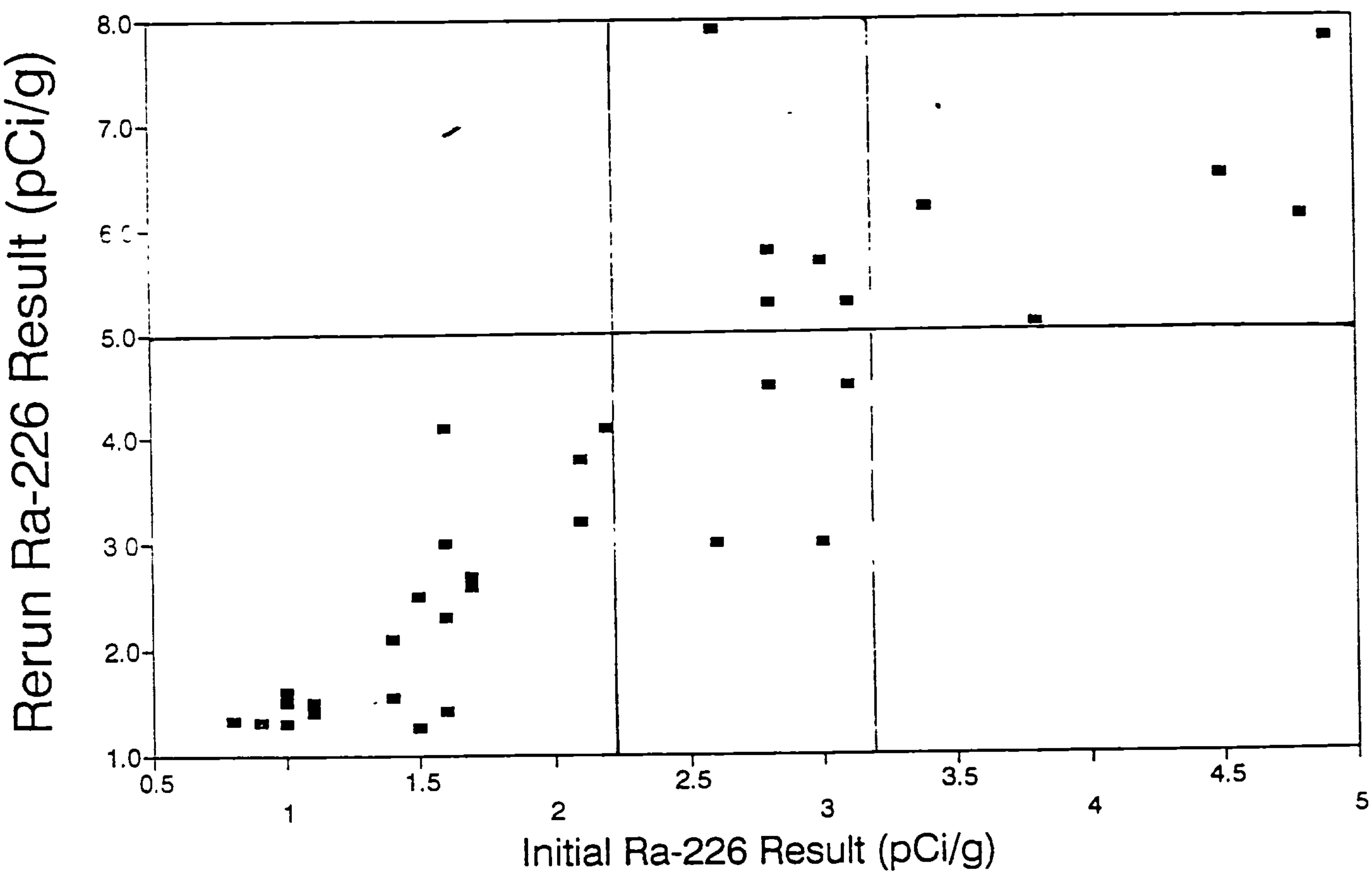
Ken Meyer
Steve Warren
Ken Greenwell
Jim Meier

Alternates: Marj Wesley
Jack Cooney
Dan Hoffman

cc: Melissa Lutz

Ra226 Concentration Range

Background - 5.0 pCi/g



MORRISON KNUDSEN CORPORATION

MK-FERGUSON GROUP

INTER-OFFICE CORRESPONDENCE

DATE: November 20, 1995

TO: ALARA Committee

FROM: Richard Machado/Michelle French MF

SUBJECT: TH232 DETERMINATION FOR SITE CONFIRMATION SAMPLES

Th232 can occur in two forms at the site: (1) naturally and (2) processed to purify Th232. Both of these forms are subject to the same transformation equation. Given a Th232 half life of 1.39×10^{10} years and a Ra228 half life of 5.75 years, a condition known as secular equilibrium occurs. Secular equilibrium occurs when the half life of the parent is very much greater than that of the daughter. If an initially pure parent (Th232) is formed, its radioactive transformation will result in accumulation of the daughter (Ra228). Since the daughter (Ra228) decays very much faster than the parent (Th232), a point is soon reached at which the amount of parent (Th232) present is equal to that of the daughter (Ra228).

The equation that represents this condition of secular equilibrium is:

$$Q_B = Q_A (1 - e^{-\lambda_B t})$$

where Q_A=parent (Th232) activity, Q_B=daughter (Ra228) activity, t=time since placement of material, and λ_B=decay constant for daughter (Ra228). Therefore, the fraction of daughter activity to parent activity

$$\left(\frac{A(RA\text{-}228)}{A(Th\text{-}232)}\right)$$

present at the WSSRAP in 1995 can be calculated.

Assume that production ceased at the site on January 1, 1965, and that all Th232 was produced on that very last day (t=30.9 years). Given a half life for Ra228 of 5.75 years, the decay constant would equal

$$(\lambda_B = 0.121\ Y^{-1})$$

11-30-95

Given this information, the ratio of Ra228 activity to Th232 activity can be calculated as follows:

$$\frac{Q_B}{Q_A} = \frac{A\,(Ra\text{-}228)}{A\,(Th\text{-}232)} = 1 - e^{-\lambda_B t}$$

$$\frac{A\,(Ra228)}{A\,(Th232)} = 1 - e^{-(0.121Y^{-1})\,(30.9Y)} = 1 - 0.024 = 0.976$$

$$\therefore \frac{A\,(Ra\text{-}228)}{A\,(Th\text{-}232)} = 0.976 \quad or \quad A\,(Th\text{-}232) = 1.025\,A\,(Ra\text{-}228)$$

This representation will be true for both naturally occurring Th232 and processed Th232. The other situation to be addressed includes the circumstance when Ra228 and associated decay products were placed as a waste material after purification of Th232. In this situation, the amount of Ra228 present will be much greater than the Th232 present. This information is illustrated in a previous assessment of the ratio of Ra228 concentrations to that of Th232 in raffinate pit wastes. The average ratio was reported as 7.02 in the *Concentration Ratios of Radionuclides* in the U238, U235, and Th232 *Decay Series* (DOE/OR/21548-250), indicating that the average activity concentration for Th232 is 0.14 of the activity concentration for Ra228.

The Record of Decision states that if Th232 and Ra228 are present and not in secular equilibrium, the cleanup criteria apply for the radionuclide with the higher concentration. Thus, for determination of successful cleanup, the use of a Ra-228 ALARA goal of 4.88 pCi/g and a criteria of 6.05 pCi/g will result in removing Th232 to within 5 pCi/g (ALARA) and 6.2 pCi/g (criteria), respectively.

Given this practice, it is recommended that the on-site radiological analyses for Ra-228 concentrations in soil be used to determine attainment of Th-232 cleanup. It is also recommended that 2% of the samples (1 of every 50) that are independently analyzed via an off-site facility be used as a quality check for all radionuclides of interest (U238, Th230, Th232, Ra228, and Ra226).. In addition, these numbers should be summarized in post remediation reports for each work package to support the decision to use Ra228 to determine successful cleanup of Th232.

RM/MF/jn   <u>Distribution</u>: ALARA Committee

Steve Warren	Alternates:	Marj Wesley
Ken Meyer		Jack Cooney
Ken Greenwell		Dan Hoffman
Jim Meier		Melissa Lutz

MORRISON KNUDSEN CORPORATION

MK-FERGUSON GROUP

INTER-OFFICE CORRESPONDENCE

DATE: April 27, 1999

TO: Dan Hoffman

FROM: Dave Cowell DC

SUBJECT: RA-226 RECOUNTS

In an effort to eliminate repetitive work, the on-site lab performed a study to determine if recounts 30 days after sealing sample cans was necessary for samples that have background or near background Ra-226 concentrations. As a result of the study, the lab will now only perform Ra-226 recounts for samples that fail the Radium ALARA preliminary calculation.

This calculation will involve multiplying the Ra-226 result by a correction factor of 2.27 (established in an IOC dated 11/17/95) and adding it to the Ra-228 result. If this result is greater than 5 pCi/g then that sample will be held and recounted 30 days later with the intention of reducing the final reported value.

This approach is conservative because the correction factor of 2.27 was established using samples with concentrations of up to 8 pCi/g. Samples having near background concentrations of Ra-226 do not ingrow to that level. Additionally, the correction factor was intended identify samples with Ra-226 levels that could exceed 5 pCi/g and did not account for the contribution from Ra-228, which we will include in this new calculation.

The attached page is included to illustrate the results of the study.

DC/jn

Attachment

Cc: Jim Meier
Steve Warren
Dave Hixson
John Coniglio
Melissa Lutz
Randy Thompson

Form 220-A 08/92